2.0 BACKGROUND

2.1 Site Description

The Facility (shown in Figure 2-1) is situated in the New Jersey Pinelands, outside of the Pinelands Preservation Area, on approximately 1,350 acres of land bordered on the east by the Toms River. Over the years, approximately 320 of the 1,350 acres was developed for manufacturing operations, waste treatment and disposal activities, and administrative and laboratory facilities. The remaining acreage is undeveloped and in its natural state. Of the 1,350 acres at the Facility, 1,240 acres constitute Dover Township's largest single tract of industrially zoned land. In addition, 72 acres are in Manchester Township and are zoned for residential use only; 39 acres are located in Dover Township (east of Oak Ridge Parkway) and are zoned conservation-residential.

Residential neighborhoods, recreational areas, small commercial establishments, and light industrial complexes are present in the vicinity of the Facility. The commercial areas are situated primarily southwest of the Facility along Route 37. The area west of the Facility is zoned for industrial use, light manufacturing, and warehousing operations. A large recreational area is located east of the Facility comprising several parks. Winding River Park is opposite the eastern portion of the Facility and Equestrian Park is opposite the northeastern portion. Residential areas exist along the northern (Pine Lake Park) and southeastern (Oak Ridge Parkway) portions of the Facility (see Figure 2-2).

Automatic gates and perimeter fencing provide security for site personnel and facilities. A rail line spur enters the Facility from the south and continues into the former production areas. The freight line was used until about 1991, and is now inactive. A road network exists both in the developed portions of the Facility and throughout the undeveloped wooded areas surrounding the former production and disposal areas.

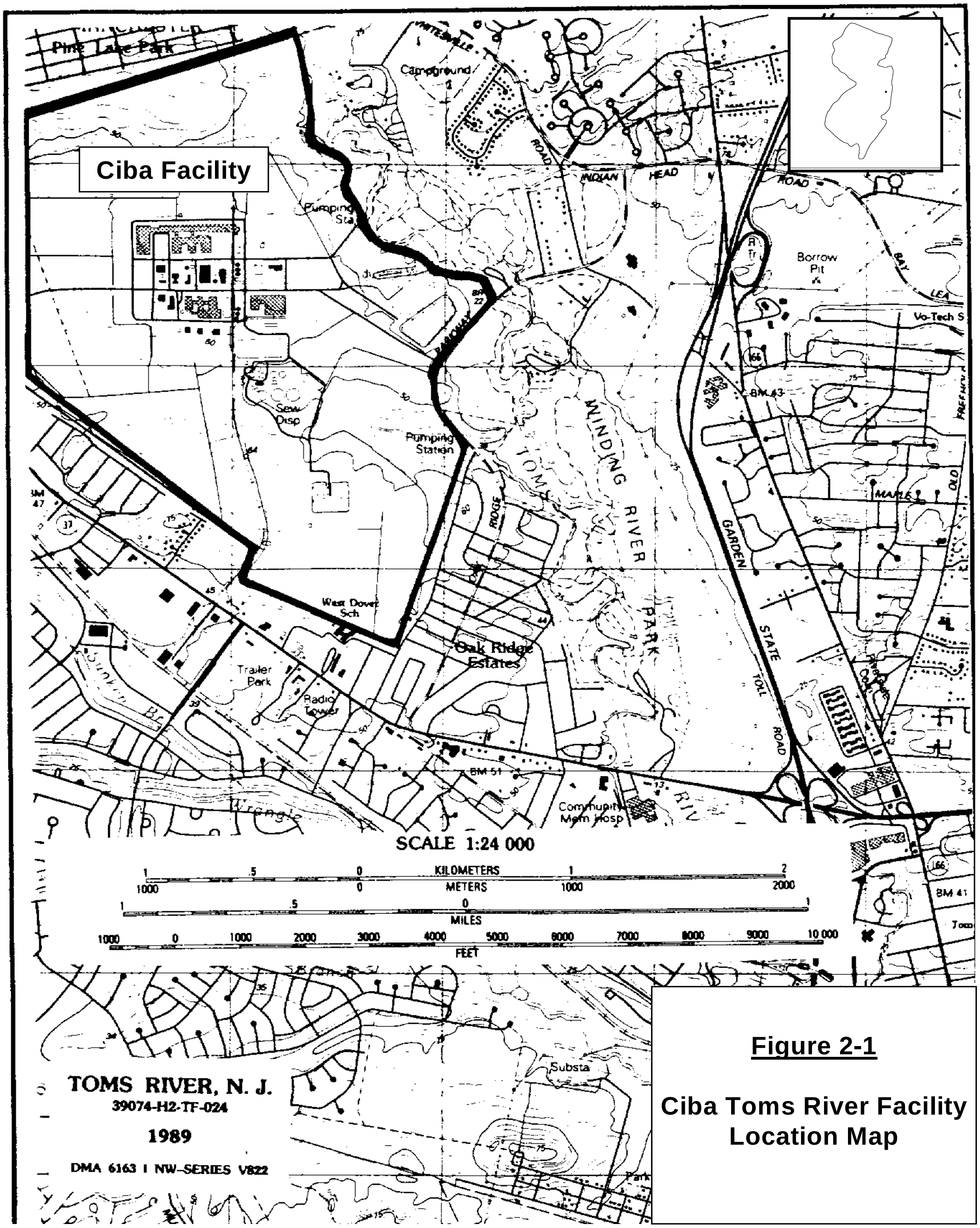


Figure 2-1

Ciba Toms River Facility Location Map

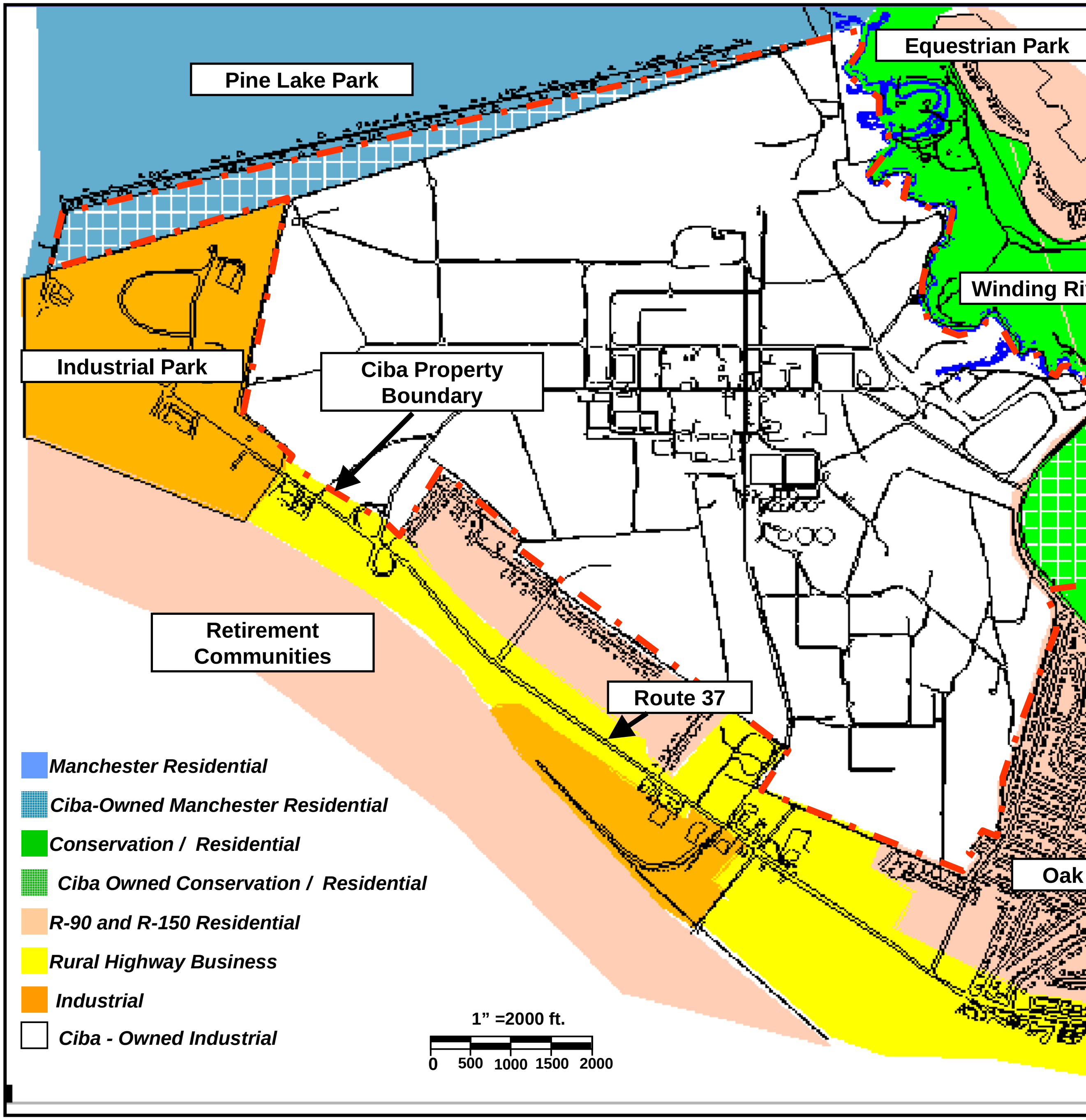


Figure 2-2

Ciba Toms River Facility Adjacent Land Use

Much of this road network supports the operation and maintenance of the groundwater extraction, treatment and recharge system (see Section 2.3.1).

At present, all former production facilities at the Facility have been demolished. Facilities exist for the Corporate Remediation Team, which conducts the current remediation activities associated with the Facility. These activities are the operation and maintenance of the groundwater extraction, treatment and recharge system, as well as the OU-2 Feasibility Study. Fully functioning water, sewer and electrical utility systems remain in place. Sanitary wastewater is pretreated on-site in a separate treatment system and discharged to the Ocean County Utilities Authority publicly owned treatment works. The water and electric systems also support operations and maintenance activities associated with the NJDEP-permitted Active Landfill (for wastewater treatment plant sludges) and the groundwater extraction, treatment and recharge system.

2.2 Site Operations History

2.2.1 INTRODUCTION

After it began operations in late 1952, the plant produced a variety of dyestuffs, pigments, epoxy resins and additives. Manufacturing operations changed significantly through the operating years. From 1952 to 1960, the initial manufacturing at the Facility was related to the synthesis of vat dyes. About 1960, manufacturing operations were significantly expanded to include the synthesis of azo and intermediate dyes as well as pigments, epoxy resins and additives. From mid 1960 to mid 1970, the plant again expanded operations to include azo dye color standardization. By the early 1980s, production operations began to be scaled back. Dye synthesis ceased in 1988 and the manufacture of epoxy resins ceased in 1990. In 1996, the remaining operations (standardization of dyes) were terminated. Currently only those activities associated with site remediation efforts continue.

During the entire period the Facility was operational, a wastewater treatment plant existed for the treatment and disposal of process wastewater. The wastewater treatment plant operation underwent several changes and upgrades over its lifespan due to manufacturing changes and wastewater technology improvements over time. Wastewater treatment residues generated from the wastewater treatment plant operations were periodically removed and disposed of in solid waste impoundments on the Facility.

These impoundments were also used for the disposal of some solid waste materials from the various manufacturing processes.

The activities associated with the historical operations at the Facility have resulted in contamination of surface and subsurface soils on the Facility, as well as the groundwater beneath the Facility. A number of known or suspected contaminated areas have been identified and characterized during remedial investigations of the Facility. These contaminated areas have been designated as “potential source areas” because they represent potential sources of contamination for the groundwater. Each of the potential source areas can be categorized based on the site activity that resulted in its known or suspected contamination. The three (3) major site activities were:

- Wastewater Treatment Operations
- Solid Waste Disposal
- Production-Related Activities

Figure 2-3 shows the location, name, and classification of each potential source area that was identified in EPA’s Source Control Remedial Investigation (RI) Report (CDM 1994a) and is referenced in the AOC/SOW for the Feasibility Study. Operational histories for the production area, wastewater treatment plant and each of the potential source areas are provided below. The source area histories include the following information:

- A description of the source area’s general physical features;
- How use of the source area was modified over the years (in response to changes in manufacturing processes and/or improvements in wastewater treatment); and
- A summary of waste disposal activities associated with the source area (where applicable).

A detailed characterization of the contamination associated with each potential source area is presented in Section 3, “Site Characterization.”

2.2.2 PRODUCTION AREA OPERATIONAL HISTORY

The Production Area is a 120-acre tract of land located in approximately the middle of the site property that was used for manufacturing activities (see Figure 2-4). Manufacturing activities took place from 1952 to 1996, during which time various production facilities were constructed, expanded and eventually phased out of operation. Currently, all of the buildings that were associated with historical production activities have been decommissioned and demolished, except for Building 105. This building is a former warehouse that is now being used as a repository for site documents.

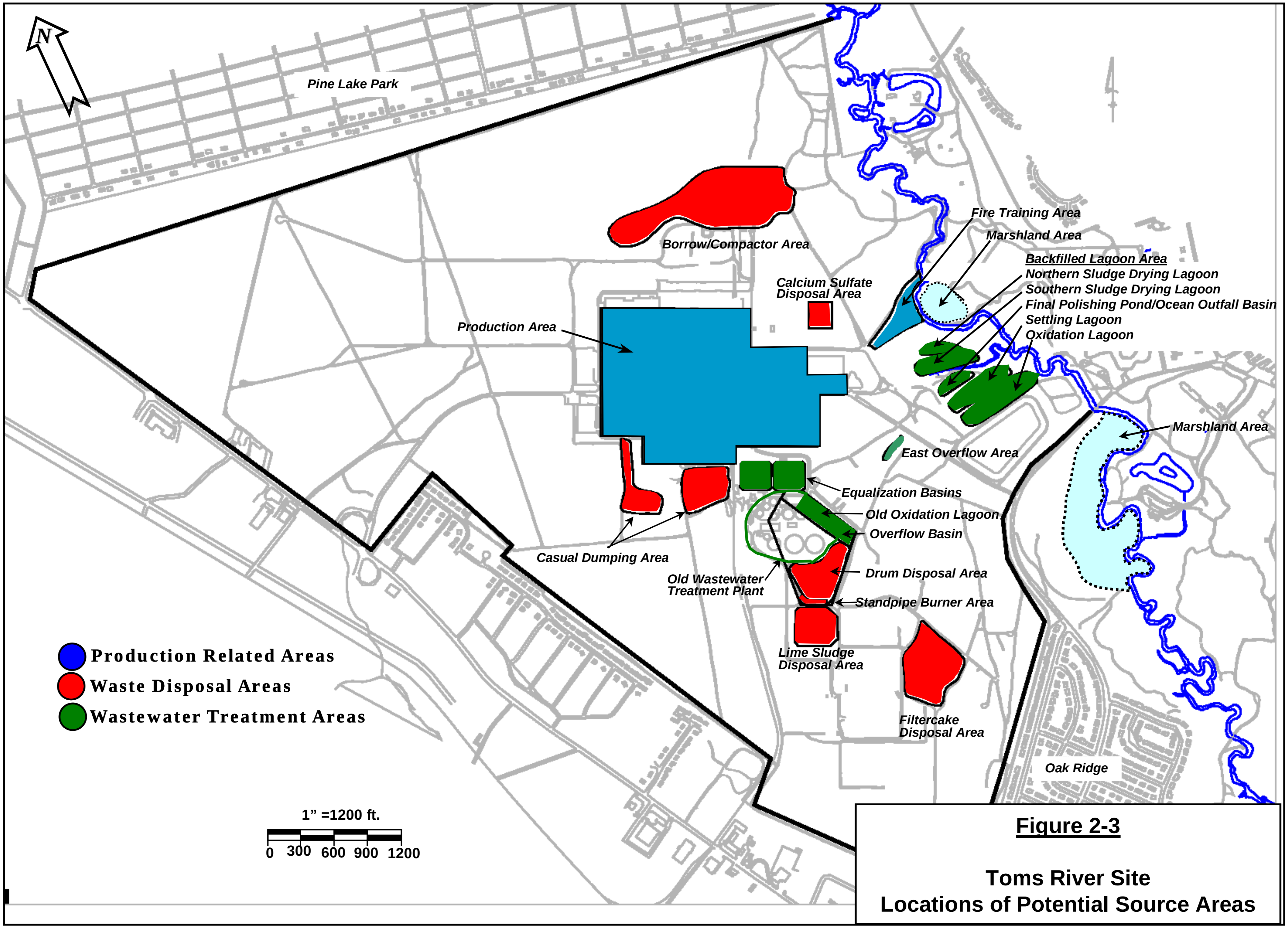


Figure 2-3

Toms River Site
Locations of Potential Source Areas

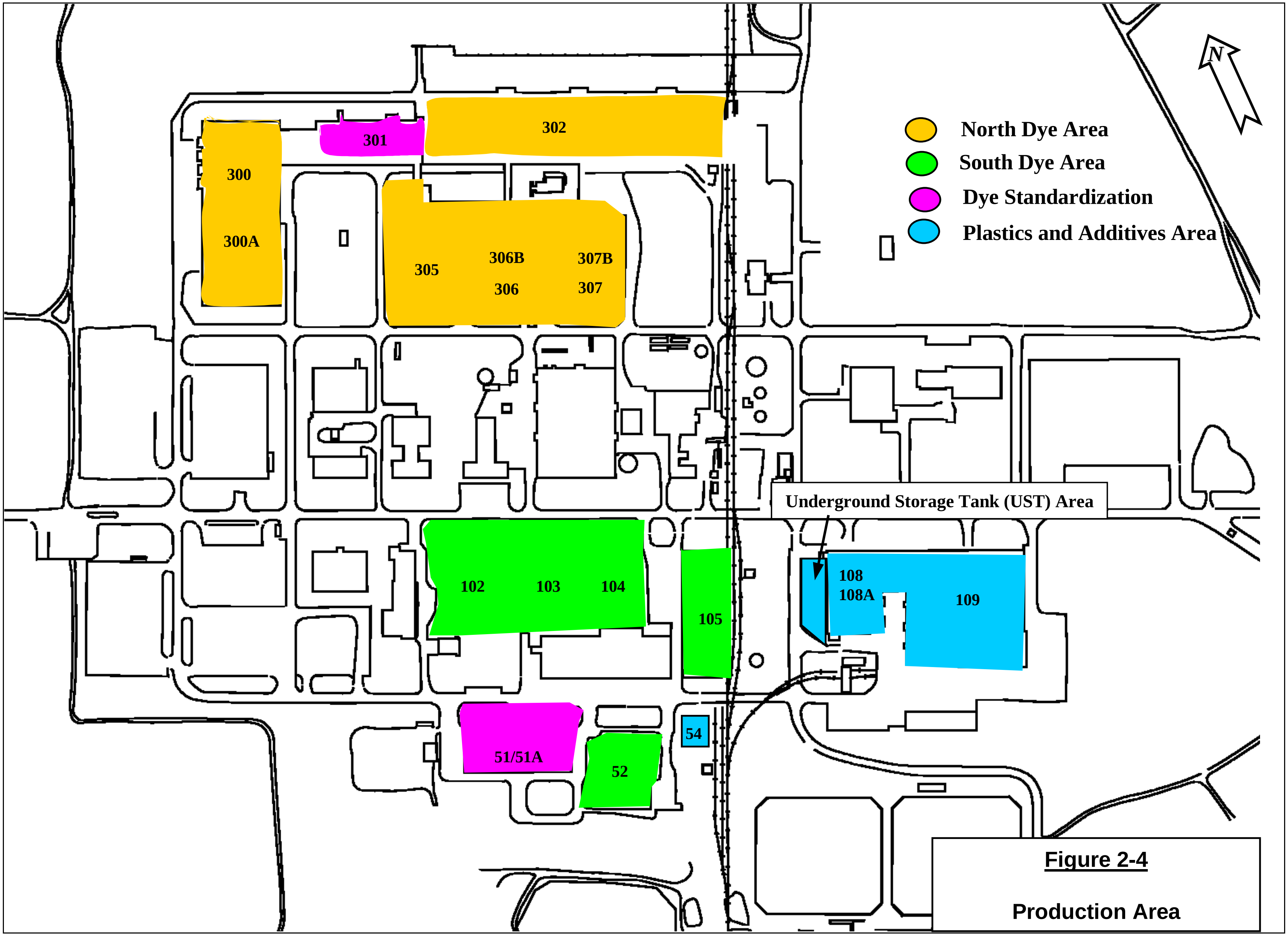


Figure 2-4

Production Area

Operational histories for the primary production areas are provided below. The other areas provided general support functions for the production facilities throughout the Facility's operational history. Examples of these support functions included administrative, engineering, maintenance, utilities and laboratory support.

2.2.2.1 South Dye Area

The South Dye Area was the location of the initial manufacturing operations at the Facility and operated from 1952 to 1984. In 1952, the South Dye Area operations consisted of three (3) production buildings (Buildings 102, 103 and 104) and one (1) warehouse (Building 105). From 1952 to 1960, anthraquinone-based dyestuffs (vat dyes) and their intermediates were produced in the South Dye Area. In 1957, a production facility (Building 52) to manufacture anthraquinone was added to the South Dye Area. Beginning in 1960, anthraquinone pigments and azo-based dyestuff (basic dye and disperse dye classes) were also manufactured in the South Dye Area.

The anthraquinone dyestuff manufacturing was a solvent-based chemistry. The major solvents used in the South Dye Area operations include chlorobenzene, 2-chlorotoluene, dichlorobenzenes, trichlorobenzenes, nitrobenzene, methanol, isopropyl alcohol, and pyridine. Other chemicals that were used in many manufacturing processes in this area include anthracene, naphthalene, phenol and anthraquinones.

Throughout its operational history, production wastewater from the South Dye Area was processed through the wastewater treatment plant. The South Dye Area operations generated several types of solid waste materials for disposal, including: clarification residues from dye synthesis; limed arsenic and iron oxide sludges; off-spec products, laboratory wastes and trash. Historical documents indicate that various solid waste materials from the South Dye Area were disposed of in several on-site waste disposal units, including the Filtercake Disposal Area, the Lime Sludge Disposal Area and the Drum Disposal Area.

2.2.2.2 Plastics and Additives Area

From 1960 to 1990, a production facility (Building 108), laboratory (Building 108A) and warehouse (Building 109) were used for the manufacture and storage of resins (i.e., epoxy cresol novalac and bisphenolic liquid resins), additives (i.e., optical brightners and ultraviolet stabilizers), specialty chemicals and insoluble pigments. Various solvents (i.e., toluene, xylenes, methyl ethyl ketone, methyl isobutyl ketone, alcohols and epichlorohydrin) were used in several of these processes. Many of these solvents were stored in underground storage tanks (USTs) west of Building 108.

In the early 1960s, an additional production facility (Building 54) was built to manufacture epichlorohydrin for the Building 108 production operations. Waste materials from the production of epichlorohydrin contained 1,2,3-trichloropropane.

Process wastewater from the production facilities was sent to the wastewater treatment plant via a series of underground sewers. Historical documents indicate that there were repairs made to both the sewers and underground trenches due to plugging and leakage.

The manufacturing operations in Building 108 generated a significant amount of solid waste materials, including sparkler filter cake from epoxy resin production, filters, sludges and laboratory wastes. Historical documentation indicates that the majority of these waste materials were disposed of in the Drum Disposal Area.

2.2.2.3 North Dye Area

In the early 1960s, manufacturing facilities were expanded to include the production of azo- based dyestuffs and their intermediates. These classes of azo-based dyestuffs included acid, basic, direct, disperse, metal complex and reactive dyes. The new facility consisted of four (4) production buildings (Buildings 301, 305, 306 and 307), two (2) laboratories (Buildings 306B and 307B) and two (2) warehouses (Buildings 300/300A and 302). This complex, which was known as the North Dye Area, operated from 1960 to 1988.

Building 307 was used to produce the dyestuff intermediates that were components of the azo-based dyestuffs. Dyestuff intermediate manufacturing in this building was water-based or inorganic solvent chemistry. It generally consisted of chemical reactions involving amines and aromatic derivatives of benzene or naphthalene.

Azo-based dyestuffs were produced in Buildings 305 and 306. Azo dye manufacturing is water-based chemistry. It generally consists of a diazotization reaction involving an aromatic amine and then a coupling reaction where the resulting diazo compound is coupled to either an aromatic hydroxyl compound or aromatic amine. In Building 301, the resulting dyestuffs were then standardized or spray dried into a final saleable form.

Process wastewater from the North Dye Area was sent to the wastewater treatment plant via a series of underground sewers. Very little solid waste materials other than trash and garbage were generated from the North Dye Area as compared to the manufacturing operations in the South Dye Area or the Building 108/UST Area. Since organic solvent use was minimal in the synthesis of azo dyestuffs, some waste materials (i.e., clarification residues, off-spec products) were slurried in water and sent to the wastewater treatment plant for disposal via the sewer systems. Regarding on-site waste disposal, clarification residues were drummed and disposed of in the Active Landfill. Neutralized sulfuric acid residue and iron oxide sludge from the production of azo intermediates was disposed of in the Calcium Sulfate Disposal Area and Drum Disposal Area, respectively.

2.2.2.4 Dye Standardization

Buildings 103, 301 and 51/51A comprised the dye standardization operations. Building 103 began operating in 1952 to support South Dye Area operations. Buildings 51/51A and 301 were constructed in the 1960s primarily to support the North Dye Area operations, although some South Dye Area dyestuffs were processed in Building 51/51A. These buildings were used to do the wet standardization of disperse dyes and spray drying operations that were necessary to finish other dyestuffs (i.e., acid, basic and direct dyes). No chemical reactions took place in any of these buildings. Buildings 103, 301 and 51/51A were decommissioned in 1984, 1988 and 1996, respectively.

2.2.3 WASTEWATER TREATMENT PLANT OPERATIONAL HISTORY

The wastewater treatment plant was upgraded several times during the operational history of the Facility, particularly as production facilities expanded. Descriptions of the first, second and third generation wastewater treatment plants are provided below and flow diagrams for each generation are shown on Figures 2-5a, 2-5b and 2-5c.

2.2.3.1 First Generation Wastewater Treatment Plant (1952-1959)

The first generation wastewater treatment plant supported the initial South Dye Area production and was in operation from late 1952 to about 1960. The treatment process included equalization, neutralization, settling and biological oxidation of process wastewater from the vat dye manufacturing operations.

These processes took place in the original (West) Equalization Basin, the Old Settling Basin and the Old Oxidation Lagoon (see Figure 2-5a).

Wastewater was first discharged into the West Equalization Basin where sodium hydroxide or lime was added. The treated wastewater (effluent) from the West Equalization Basin was then pumped into the Old Settling Basin, which was used to settle out residue through gravity. The effluent from the Old Settling Basin was then discharged to the Old Oxidation Lagoon, which used mechanical aeration to mix the wastewater. After aeration, the final effluent was chlorinated and then discharged to the Toms River. The wastewater treatment sludge from the treatment units was periodically removed and placed in the Filtercake Disposal Area.

2.2.3.2 Second Generation Wastewater Treatment Plant (1960-1977)

The wastewater treatment plant was upgraded around 1960 to support the increase in process wastewater from the added production of azo dyes, epoxy resins and additives. Similar to the first generation plant, the second generation treatment process consisted of equalization, neutralization, settling and biological oxidation (see Figure 2-5b). Wastewater from the vat dye operations continued to be equalized in the West Equalization Basin. A small East Equalization Basin was constructed around 1960 to handle the additional wastewater flow from the azo dye and resin/additive production operations. Effluent from the East and West Equalization Basins was then directed to two new primary clarifiers for settling of coarse sediments.

From the primary clarifiers, the effluent was routed though a series of lagoons now collectively known as the Backfilled Lagoon Area. This area consisted of five (5) new treatment units that were built to replace the first generation Old Oxidation Lagoon and Old Settling Basin treatment units. These new units consisted of three (3) wastewater treatment lagoons for the biological oxidation steps and sludge settling steps (the Oxidation Lagoon, the Settling Lagoon and the Final Polishing Pond) and two (2) sludge drying beds (the Northern Drying Lagoon and the Southern Drying Lagoon).

Effluent from the primary clarifiers went to the Oxidation Lagoon where it was mechanically aerated. The liquid was then transferred to the Settling Lagoon (for settling of wastewater solids) followed by the Final Polishing Pond, where the effluent pH was adjusted prior to discharge to the Toms River.

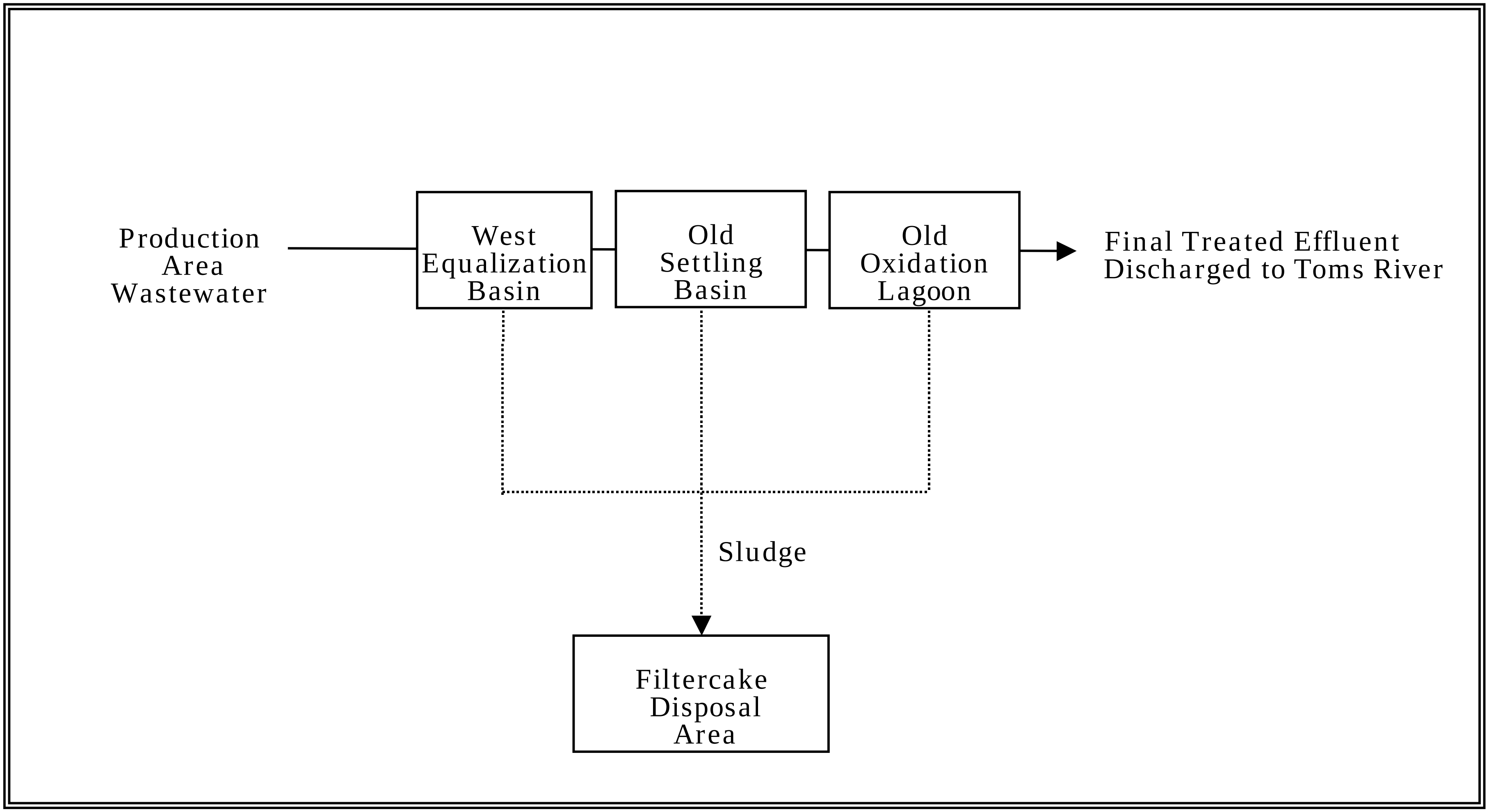


Figure 2-5A

First Generation Wastewater Treatment Process Schematic (1952 to 1959)

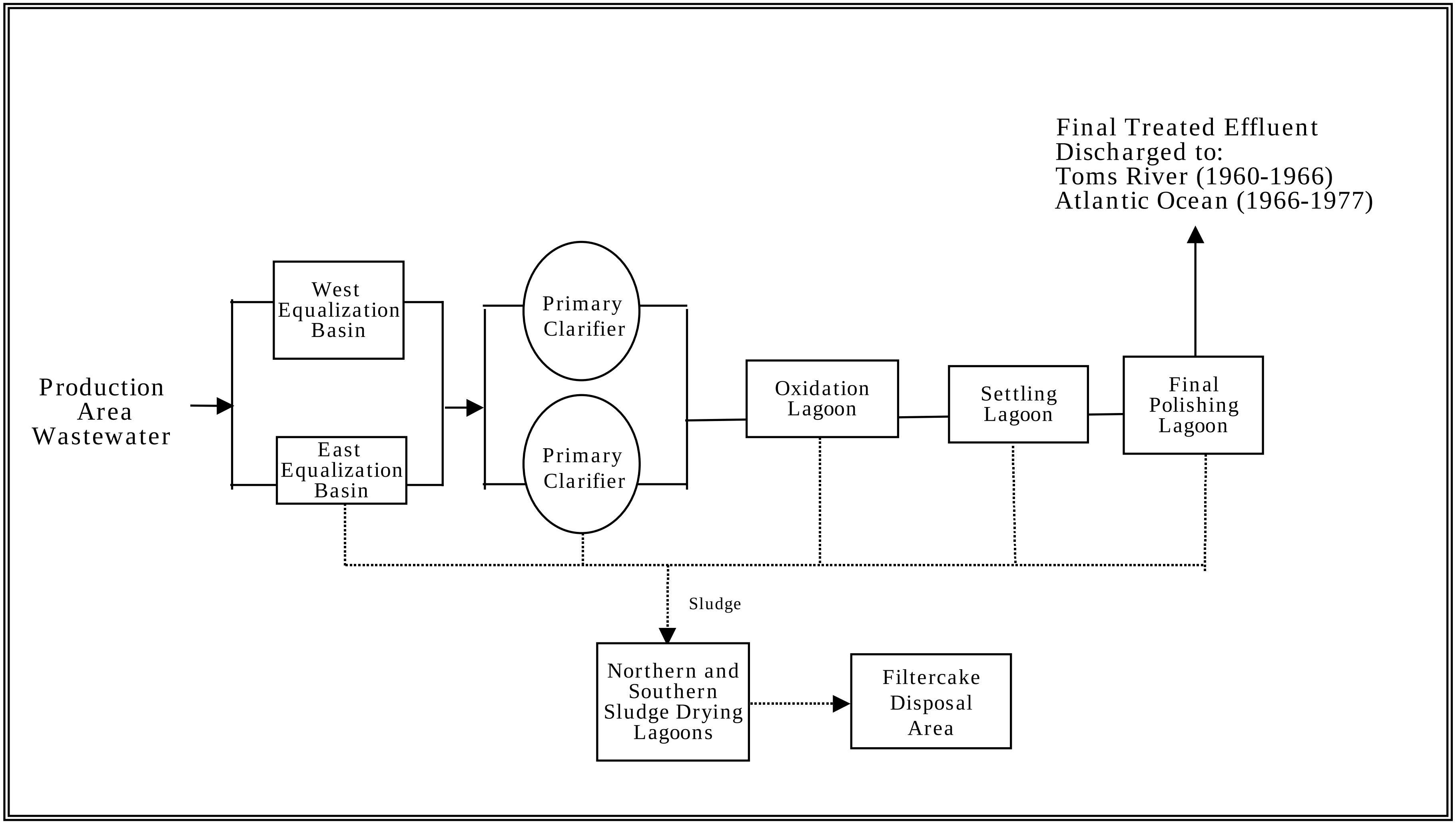


Figure 2-5B

Second Generation Wastewater Treatment Process Schematic (1960 to 1977)

Sludge removed from these three (3) treatment lagoons was placed in the Northern and Southern Drying Lagoons for dewatering.

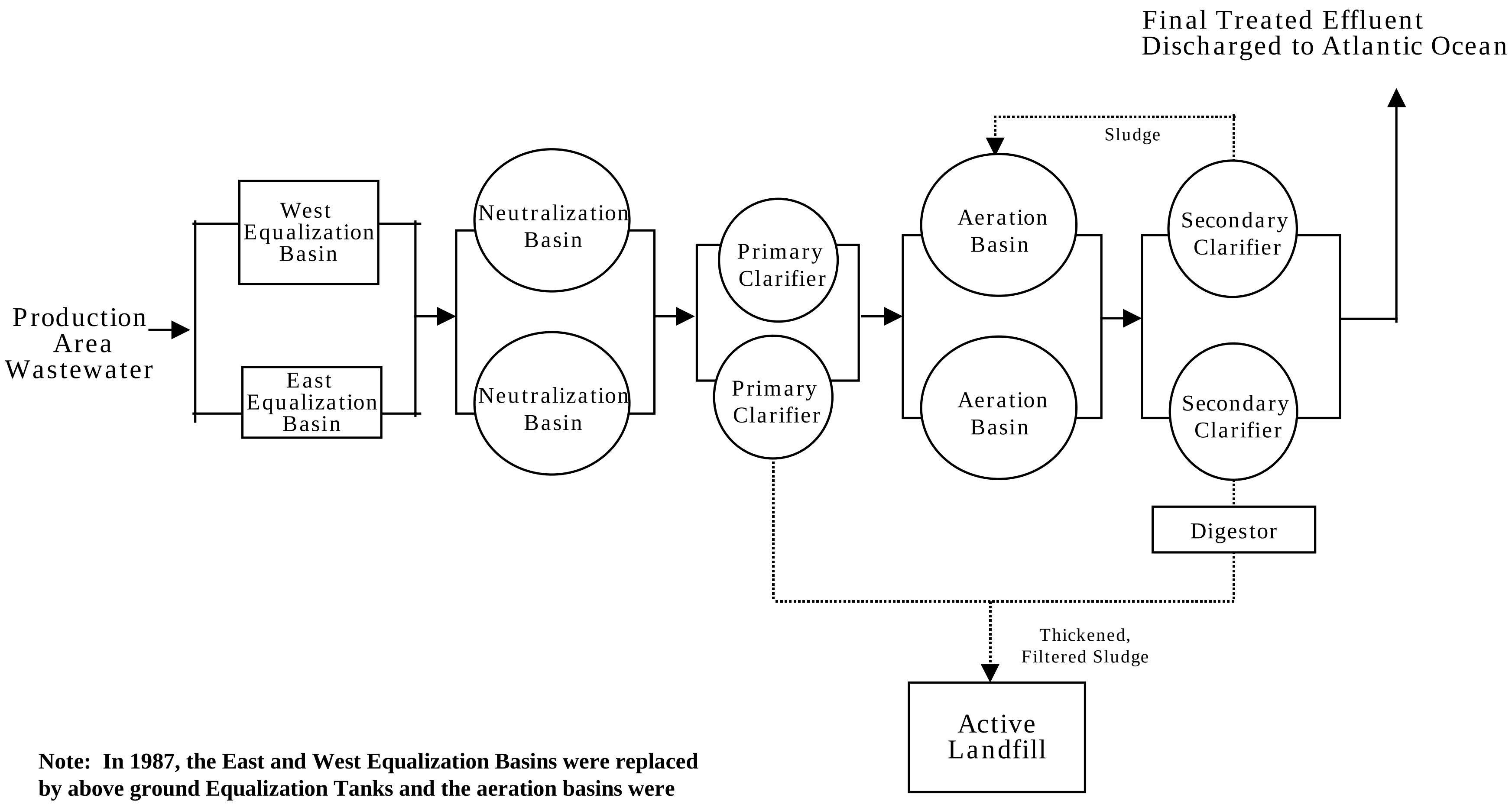
After the final polishing step, the effluent was discharged to the Toms River. In 1966, the final effluent from the wastewater treatment operation was redirected from the Toms River to the Atlantic Ocean via an eleven (11)-mile ocean discharge pipeline.

2.2.3.3 Third Generation Wastewater Treatment Plant (1977-1991)

In the early 1970s, new regulatory and production capacity requirements led to implementation of an upgraded wastewater treatment facility. The wastewater treatment process included neutralization, metals precipitation, biological oxidation and clarification to separate the biological sludges (see Figure 2-5c). Construction of these wastewater treatment facilities was completed in 1977 and the system remained in operation until 1991, when all production activities ceased.

The East and West Equalization Basins and primary clarifiers continued to operate as the preliminary neutralization and settling steps in the wastewater treatment process. However, in 1977, the East Equalization Basin was expanded to the same capacity as the West Equalization Basin. The five (5) lagoons comprising the Backfilled Lagoon Area (Oxidation Lagoon, Settling Lagoon, Final Polishing Pond, Northern Sludge Drying and Southern Sludge Drying Lagoon) were replaced by two (2) above ground aeration basins and two (2) secondary clarifiers. Sludge from the secondary clarifier was processed through a digestor to reduce the volume of sludge prior to disposal in the Active Landfill.

The wastewater from the Equalization Basins was passed through new primary and secondary neutralization basins for pH adjustment and then to the primary clarifiers where metals precipitation and solids settling took place. The effluent from the primary clarifiers was then placed in the aeration basins. Organic compounds were removed by biological degradation. The effluent from the aeration basins was pumped to the secondary clarifiers for further settling of solids. The final effluent from the secondary clarifiers discharged through the ocean pipeline. The bulk of the sludge from the secondary clarifiers was returned to the aeration basins for treatment. A small amount of sludge from the secondary clarifier was wasted to the sludge digestor. The sludges were then stabilized with lime and ferric chloride and filtered. Sludge from the primary clarifier was also filtered. The biological sludge from the primary and



Note: In 1987, the East and West Equalization Basins were replaced by above ground Equalization Tanks and the aeration basins were upgraded to a PACT® process.

<u>Figure 2-5C</u>

Third Generation Wastewater Treatment Process Schematic (1977 to 1991)

secondary clarifiers, in filtercake form, was then removed and placed in the on-site NJDEP-permitted Active Landfill.

In 1987, the East and West Equalization Basins were replaced by above ground closed equalization tanks (the neutralization/treatment process remained the same). Also at this time, the aeration process was upgraded to a Powdered Activated Carbon Treatment (PACT®) process. The final treated effluent continued to be discharged to the Atlantic Ocean until the end of 1991.

By 1991, active production at the Facility had ceased and only dye standardization operations remained. A small pretreatment facility was constructed and all process wastewater from sanitary systems, laboratories and dye standardization, as well as leachate from the Active Landfill, were pretreated and then discharged to the Ocean County Utilities Authority publicly-owned treatment works under permit. The existing treatment plant, which was used to treat process wastewater beginning in 1977 and contaminated groundwater beginning in 1985, was used solely for treatment of groundwater after 1991. After 1991, the above ground equalization tanks, neutralization basins and primary clarifiers were taken out of service. The "groundwater" treatment system, which consisted of PACT® aeration, clarification and granulated activated carbon (GAC) treatment, was subsequently upgraded as part of the groundwater extraction, treatment and recharge system currently in operation at the Facility (see Section 2.3.1).

2.2.4 POTENTIAL SOURCE AREAS ASSOCIATED WITH WASTEWATER TREATMENT OPERATIONS

In the Source Control RI Report (CDM 1994a), EPA identified the following potential source areas associated with historical wastewater treatment operations:

- Old Wastewater Treatment Plant (includes part of the Old Settling Basin)
- Old Oxidation Lagoon
- Equalization Basins (comprised of the East and West Equalization Basins)
- Backfilled Lagoon Area (comprised of the Oxidation Lagoon, Settling Lagoon, Final Polishing Pond, Northern Drying Lagoon and Southern Drying Lagoon)
- Ocean Outfall Basin (part of the Final Polishing Pond)
- Overflow Basin
- East Overflow Area

The locations of these potential source areas are shown on Figure 2-6. These areas were used in the on-site wastewater treatment process that was in operation from 1952 to 1996, except the East Overflow Area. The East Overflow Area was identified in the Source Control RI Report (CDM 1994a) as a potential impoundment where wastewater from two of the Backfilled Lagoon Areas (the Oxidation Lagoon and Settling Lagoon) could have potentially overflowed.

A physical description and chronology of the operational history for each potential source area associated with historical wastewater treatment operations is presented below.

2.2.4.1 Old Wastewater Treatment Plant and Old Oxidation Lagoon

The locations of the Old Wastewater Treatment Plant and Old Oxidation Lagoon, which refer to treatment areas from the first generation wastewater treatment process, are shown on Figure 2-7. The Old Wastewater Treatment Plant refers to the portions of the Old Settling Basin not currently occupied by the Drum Disposal Area. The Old Settling Basin was the fourteen (14) acre unlined lagoon used for sludge settling. The Old Wastewater Treatment Plant area is currently covered by the buildings, tanks and paved areas that comprised the third generation wastewater treatment plant.

The Old Oxidation Lagoon was the three (3) acre unlined impoundment (see Figure 2-7) where effluent from the Old Settling Basin was mechanically aerated as part of the first generation wastewater treatment process. As part of the second generation wastewater treatment plant upgrade, the Overflow Basin and East Equalization Basin were built over part of the Old Oxidation Lagoon (the southeastern end and the northwestern end, respectively).

Usage of the Old Oxidation Lagoon and Old Settling Basin began about 1954 and continued until about 1960 (Eckenfelder 1993). Historical aerial photographs outline the physical changes in these areas over time (EPIC 1984). The first photographs of the Old Oxidation Lagoon and Old Settling Basin were taken in 1956. The Old Oxidation Lagoon appears as a rectangle approximately three (3) acres, filled with liquid. Parallel surface aeration lines are visible within the lagoon. In a 1956 photograph the Old Settling Basin is irregular in shape and appears to be almost completely filled with liquid. In photographs taken in 1965 and 1976, drum disposal is visible in the southeastern portion of the Old

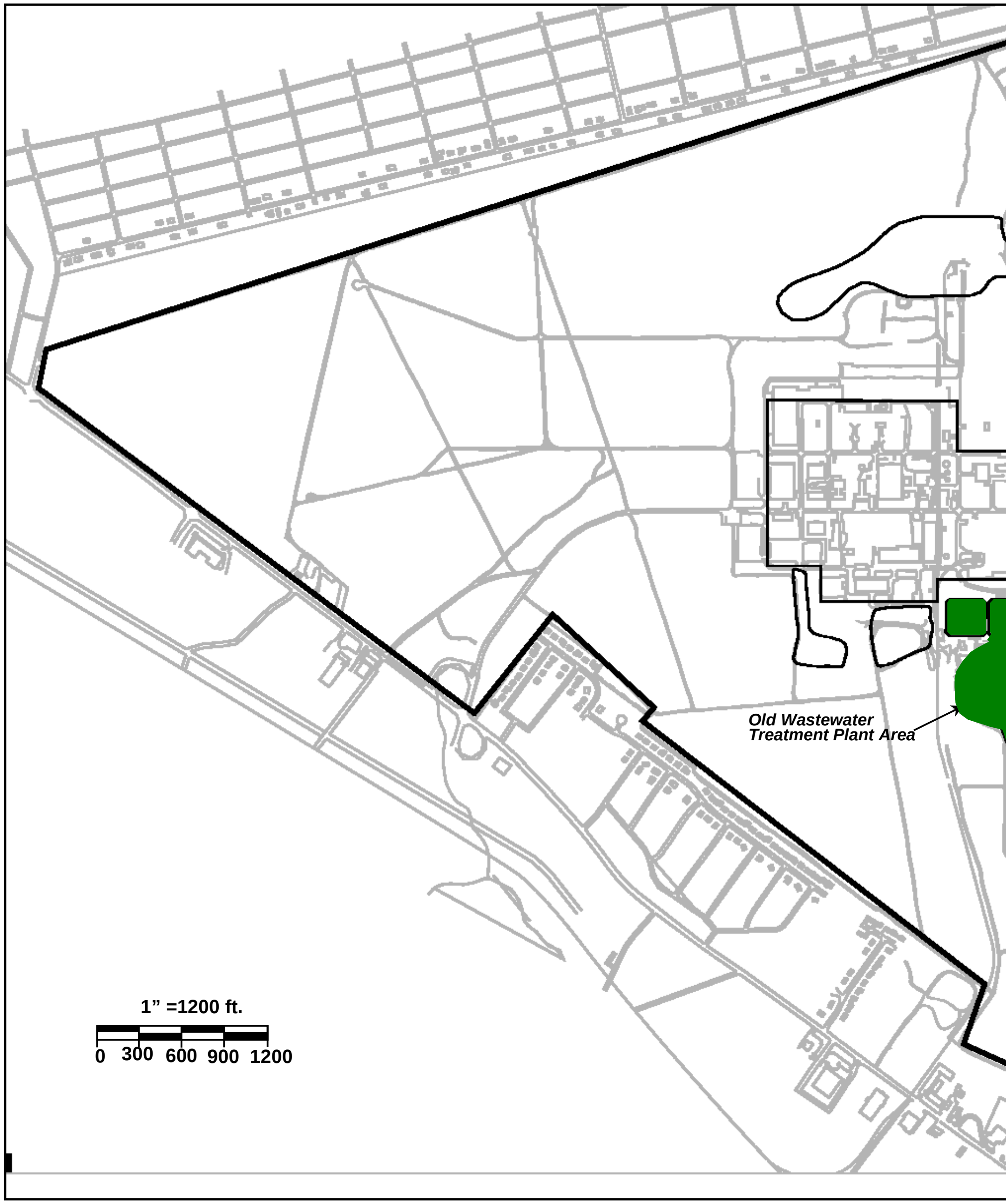


Figure 2-6

Potential Source Areas Associated with Historical Wastewater Treatment Operations

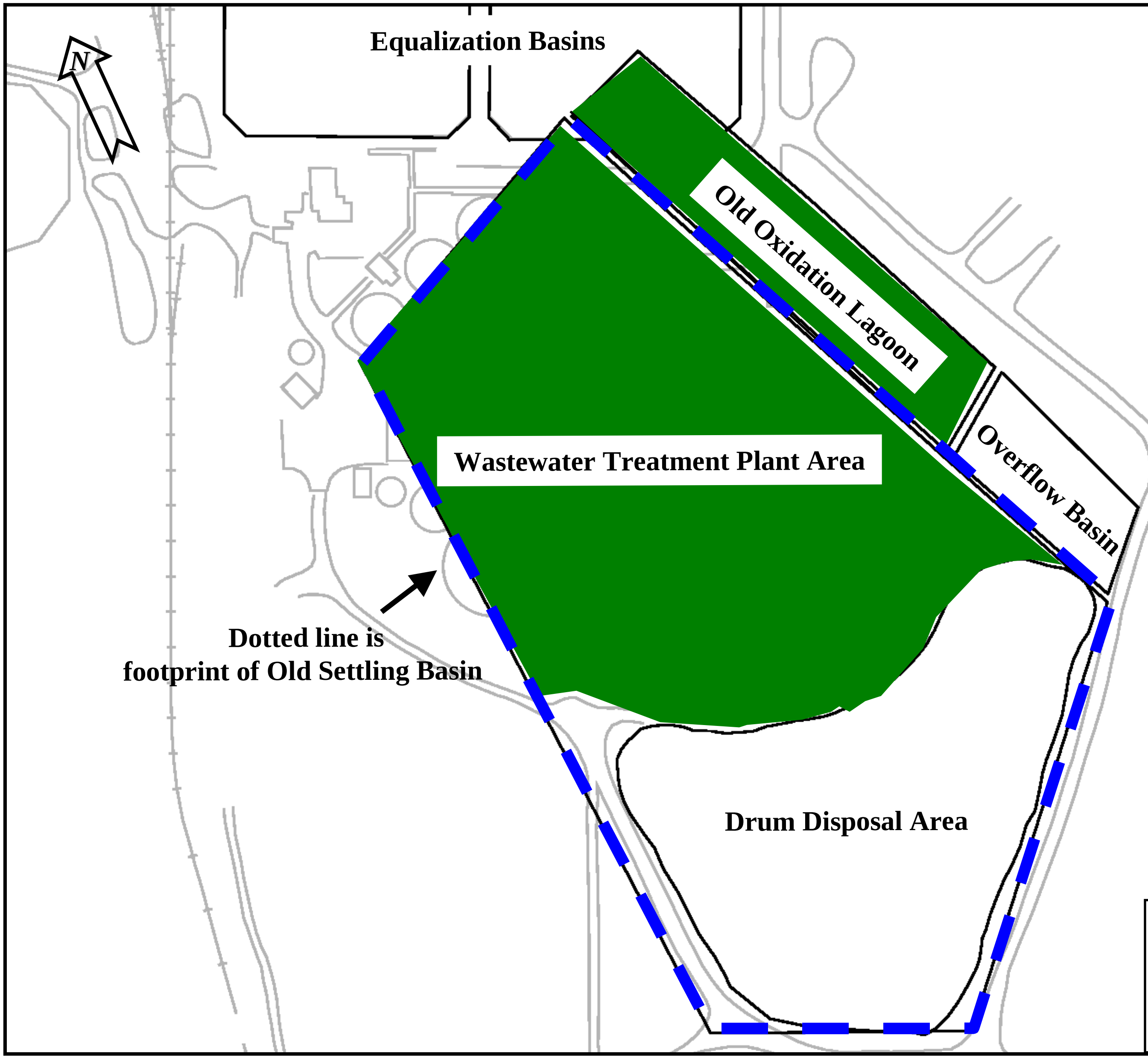


Figure 2-7

Old Wastewater Treatment Plant and Old Oxidation Lagoon

Settling Basin, which is now part of the Drum Disposal Area. In the 1976 photograph, earth moving activity is on-going in both the Old Oxidation Lagoon and Old Settling Basin as part of the wastewater treatment plant upgrade, and only small amounts of sludge are visible.

An aerial photograph taken in 1983 shows that the third modification to the wastewater treatment plant had been completed by that time. The Old Oxidation Lagoon was covered by the East Equalization Basin, the Overflow Basin, and partially by pavement. The southeastern portion of the Old Settling Basin (part of the current Drum Disposal Area) was capped and the northwestern portion of the Old Settling Basin was developed with several large tanks, buildings and clarifiers. Both this northwestern portion and the area northwest of the Old Settling Basin boundary are paved in the 1983 photograph.

Historical information regarding the Old Settling Basin and Old Oxidation Lagoon indicate that there was substantial sludge accumulation in these areas. This was especially true for the Old Settling Basin, since its purpose was to remove coarse sediments from the wastewater. Historical records indicate that sludge was periodically removed from these basins and sent to the Filtercake Disposal Area (Geonics 1983, AWARE 1986, Eckenfelder 1993). During the 1960s, sludge slurry from some of the second generation wastewater treatment process units (i.e., Equalization Basins, Oxidation Lagoon and Settling Lagoon) was occasionally placed in the Old Settling Basin. In 1976, the Old Settling Basin was cleaned out to make way for the wastewater treatment plant expansion and the sludge was disposed of in the Filtercake Disposal Area.

2.2.4.2 East and West Equalization Basins

The locations of the East and West Equalization Basins are shown on Figure 2-8. At their full operating capacity, the basins were each approximately three (3) acres with a depth of fourteen (14) feet and an overall capacity of approximately 6.7 million gallons (AWARE 1987). The basins were an integral component of the wastewater treatment process until 1987, when they were replaced by the above ground closed equalization tanks. During their operation, the basins were used to balance and neutralize wastewater prior to the solids settling and aeration treatment steps. The wastewater consisted of combined pre-treated sanitary and process wastewater and was corrosive, with a pH less than 2 (AWARE 1987).

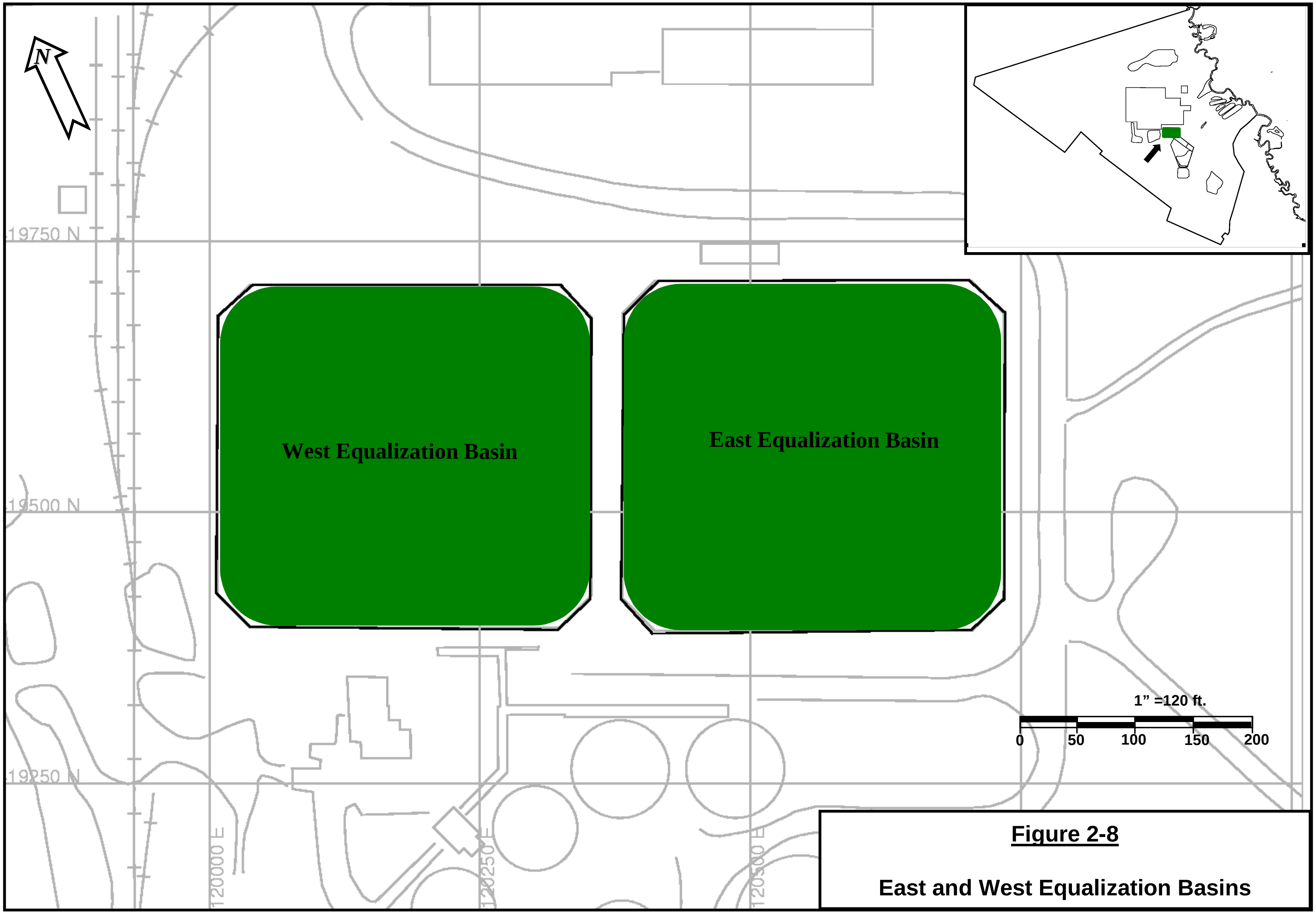


Figure 2-8

East and West Equalization Basins

The history of the basins is well documented in plant historical records as well as aerial photographs (EPIC 1984). The original (West) Equalization Basin, which was part of the first generation wastewater treatment plant, began operating about 1952, accepting vat dye wastewater from the South Dye Area operations. This basin was originally lined with an asphalt material (Eckenfelder 1993). The earliest photograph was taken in 1956, which shows that the West Equalization Basin was functional and completely filled with liquid. The West Equalization Basin was constructed at its full size as part of the first generation wastewater treatment plant. Historical plant records indicate that during this operational period in the 1950s, the asphalt liner in the West Equalization Basin deteriorated from contact with organic compounds contained in the process wastewater.

In 1959, the West Equalization Basin was re-lined with a double liner and leachate collection system. The liner construction consisted of a top liner made of asphalt-impregnated felt material, a leachate collection system, and a second polyethylene liner underlying the leachate collection system. At the same time, the East Equalization Basin was constructed at about half its final size with the same double liner and leachate collection system (Eckenfelder 1993). The East Equalization Basin was built to receive azo dye and resin process wastewater from the North Dye Area and the Building 108 Area manufacturing operations. The West Equalization Basin continued to receive process wastewater from the South Dye Area manufacturing operations. From 1961 to 1973, historical records indicate that sections of the liners in both basins were repaired or replaced on several occasions.

In 1977, both basins were re-lined with double Hypalon liners with one (1) foot of sand and a leak detection system, consisting of crushed stone wrapped in Typar between the layers, and one (1) foot of sand on top of the upper liner (AWARE 1987). These liners were specifically designed to prevent seepage from the basins. However, Hypalon proved not to be resistant to many of the organic compounds in the wastewater at the Facility, and indications are that the liners did not always perform satisfactorily. The East Equalization Basin was also expanded to its full size in 1977, and was partially built over the northwest corner of the Old Oxidation Lagoon, which was no longer in use.

Historically, while one basin was being relined/repaired, all process wastewater was diverted to the other operating basin. Non-pumpable sludge was removed from the basins and disposed of in the Filtercake Disposal Area or the Sludge Drying Lagoons of the Backfilled Lagoon Area. Pumpable sludge slurry was disposed of in the Old Settling Basin.

As indicated earlier, the Equalization Basins operated until 1987, when they were replaced by the above ground closed equalization tanks. In 1991 and 1992, the West and East Equalization Basins, respectively, were closed according to Resource Conservation and Recovery Act (RCRA) protocol. Pumpable liquid, accumulated sludge, the liners and underlying soils that were visually contaminated were removed. The liquid and slurried sludge was processed through the third generation wastewater treatment plant. Non-pumpable sludge and contaminated soils were disposed of off-site. During the closure, significant liner failure in the West Equalization Basin was evident. The East Equalization Basin liner was in much better condition and the resinous nature of the waste appeared to have formed a physical barrier on top of the Hypalon liner.

2.2.4.3 Backfilled Lagoon Area

The Backfilled Lagoon Area consists of five (5) unlined lagoons that operated from about 1959 to 1977 as part of the second generation wastewater treatment plant (see Figure 2-9). The entire area covers approximately seven (7) acres and consisted of three (3) wastewater treatment lagoons (Oxidation Lagoon, Settling Lagoon and Final Polishing Pond) and two (2) sludge drying lagoons (Northern and Southern). These five (5) lagoons that comprise the Backfilled Lagoon Area replaced the earlier Old Oxidation Lagoon and Old Settling Basin which were utilized during the first generation wastewater treatment plant.

A 1956 aerial photograph (EPIC 1984) confirms that the Backfilled Lagoon Area did not exist and the Old Oxidation Lagoon and Old Settling Basin were still being actively used. The photograph shows the construction of the pipeline that would eventually transfer wastewater from the primary clarifiers to the Backfilled Lagoon Area as well as cleared areas for the some of the lagoons. By 1962 (EPIC 1984), the Old Oxidation Lagoon and Old Settling Basin appear to no longer be in use and although the Backfilled Lagoon Area is not visible in the photograph, it can be inferred that it was functioning in the wastewater treatment process. In a 1965 photograph (EPIC 1984), all five (5) lagoons of the Backfilled Lagoon Area are operational and contain liquid.

The Backfilled Lagoon Area received effluent following neutralization and settling of coarse solids in the Equalization Basins and primary clarifiers, respectively. From the primary clarifiers, wastewater was directed to the Oxidation Lagoon. After passing from the Oxidation Lagoon to the sludge Settling Lagoon, the wastewater was directed to the Final Polishing Pond, where it received final pH adjustment before

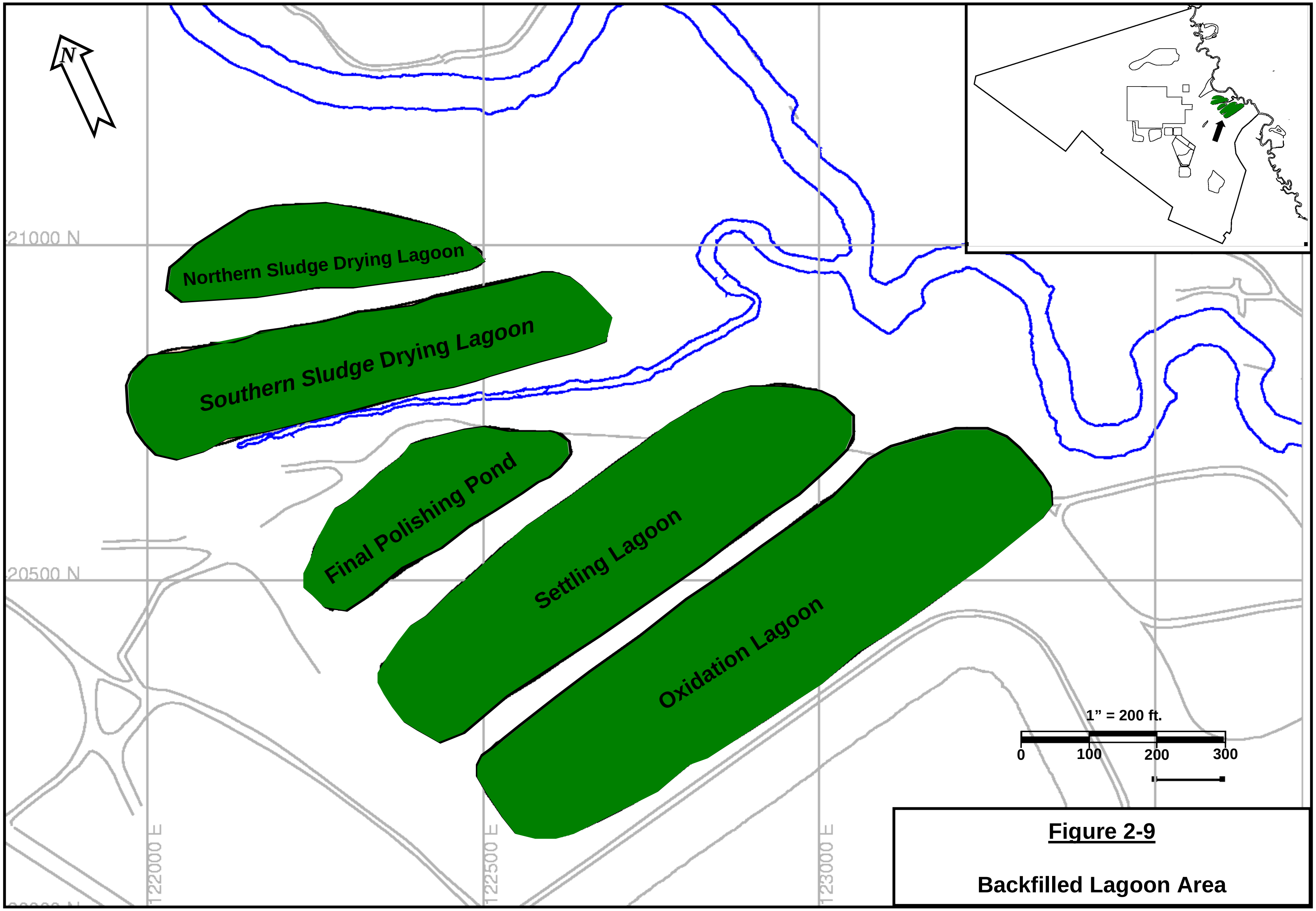


Figure 2-9

Backfilled Lagoon Area

being discharged. Prior to 1966, discharge was to the Toms River. After 1966, treated wastewater was discharged to the ocean via the ocean discharge pipeline (EPA 1994, Appendix A).

Regarding solids disposal, historical records indicate that solids slurry from the Oxidation Lagoon and Settling Lagoon was pumped into the Old Settling Basin every few years (the Basin was closed in the mid 1970s as part of the wastewater treatment plant expansion and the sludge was disposed of in the Filtercake Disposal Area). As indicated in the previous section, non-pumpable sludge from the Equalization Basins was occasionally disposed of in the North and South Sludge Drying Lagoons. During the time that the Backfilled Lagoon Area was active, dried sludge from the North and South Drying Lagoons was periodically transported to the Filtercake Disposal Area for disposal (NUS 1988a).

The third generation wastewater treatment plant began operating in 1977 and in 1978 the Backfilled Lagoon Area was closed [(NUS 1988a) (Eckenfelder 1993)]. When the lagoons were closed, water from the three (3) treatment lagoons (Oxidation Lagoon, Settling Lagoon and Final Polishing Pond) was hydraulically removed, filtered, and the resulting sludges were placed in the Active Landfill. These treatment lagoons were then backfilled. The Ocean Outfall Basin (part of the third generation wastewater treatment plant) was subsequently constructed over the northeastern end of the Final Polishing Pond. Residual dried sludge in the Northern and Southern Sludge Drying Lagoons remained in place and these two lagoons were then backfilled [(AWARE 1986) (Eckenfelder 1993)]. A 1983 photograph (EPIC 1984) shows no discernable lagoons and the area filled to grade.

It should be noted that in the Source Control RI Report (CDM 1994a), the five (5) lagoons of the Backfilled Lagoon Area were identified as being within the 100-year flood boundary (FEMA 1983). Subsequent to this report, the Federal Emergency Management Agency (FEMA) found that the flood zone map used for the assessment was incorrect. The updated FEMA map shows that the Backfilled Lagoon Area is not within the 100-year flood boundary (FEMA 1995).

2.2.4.4 Ocean Outfall Basin

The Ocean Outfall Basin is located east of the Production Area near the Toms River (see Figure 2-10). It was constructed over the eastern end of the Final Polishing Pond in the Backfilled Lagoon Area. It was about 0.4 acres in size and approximately eight (8) feet deep. From 1977 to 1985, the basin was used to

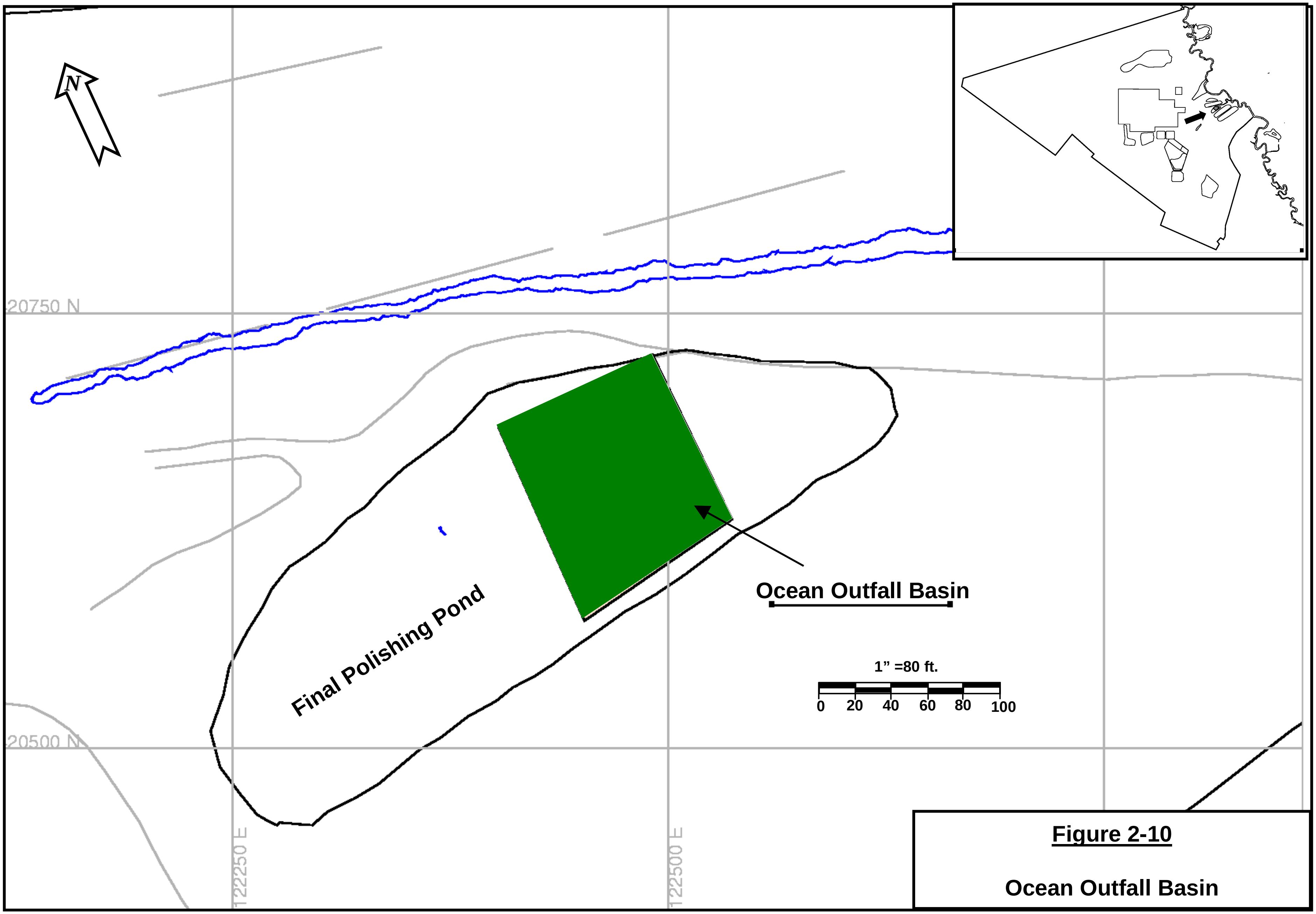


Figure 2-10

Ocean Outfall Basin

contain overflow of treated wastewater from the ocean discharge pipeline, according to a NJPDES Discharge to Groundwater Permit (NJDEPE 1990).

The Ocean Outfall Basin was lined with a synthetic membrane covered with a layer of sand (NJDEPE 1990). In May of 1985, tears were discovered in the liner and the Ocean Outfall Basin was closed (NJDEPE 1990). The basin was dewatered in June 1985, and the sludge layer was covered with layers of sand, soda ash, plastic, and additional sand (NJDEPE 1990). In 1991, the entire basin was excavated, including the sludge and the original synthetic liner, as part of the decommissioning of the ocean discharge pipeline.

2.2.4.5 Overflow Basin

The Overflow Basin is located on the eastern side of the current wastewater treatment plant (see Figure 2-11). It was built over the southeastern end of the Old Oxidation Lagoon in the early 1980s as a catch basin for surface runoff from the adjacent wastewater treatment plant. It was approximately one (1) acre with a depth of fourteen (14) feet. The Overflow Basin was decommissioned in 1991 by draining the basin and removing its plastic liner.

2.2.4.6 East Overflow Area

The East Overflow Area is located to the east and parallel to the pipeline that transported wastewater from the Equalization Basins to the Backfilled Lagoon Area (Figure 2-12). This area was identified as a “possible impoundment” based on its dark gray color in 1976 and 1983 photographs (EPIC 1984). This area is actually a parking lot and was historically covered with dark gray paving gravel, which may account for its appearance in the photographs. Other than the aerial photographic interpretation, there is no evidence that an actual impoundment ever existed in the area.

2.2.5 POTENTIAL SOURCE AREAS ASSOCIATED WITH SOLID WASTE DISPOSAL

Several solid waste disposal areas are known to have operated at different times during the Facility’s operation. The volume and composition of the wastes disposed of differed substantially from one area to another. The six (6) solid waste disposal areas identified in the Source Control RI Report (CDM 1994a), were the following:

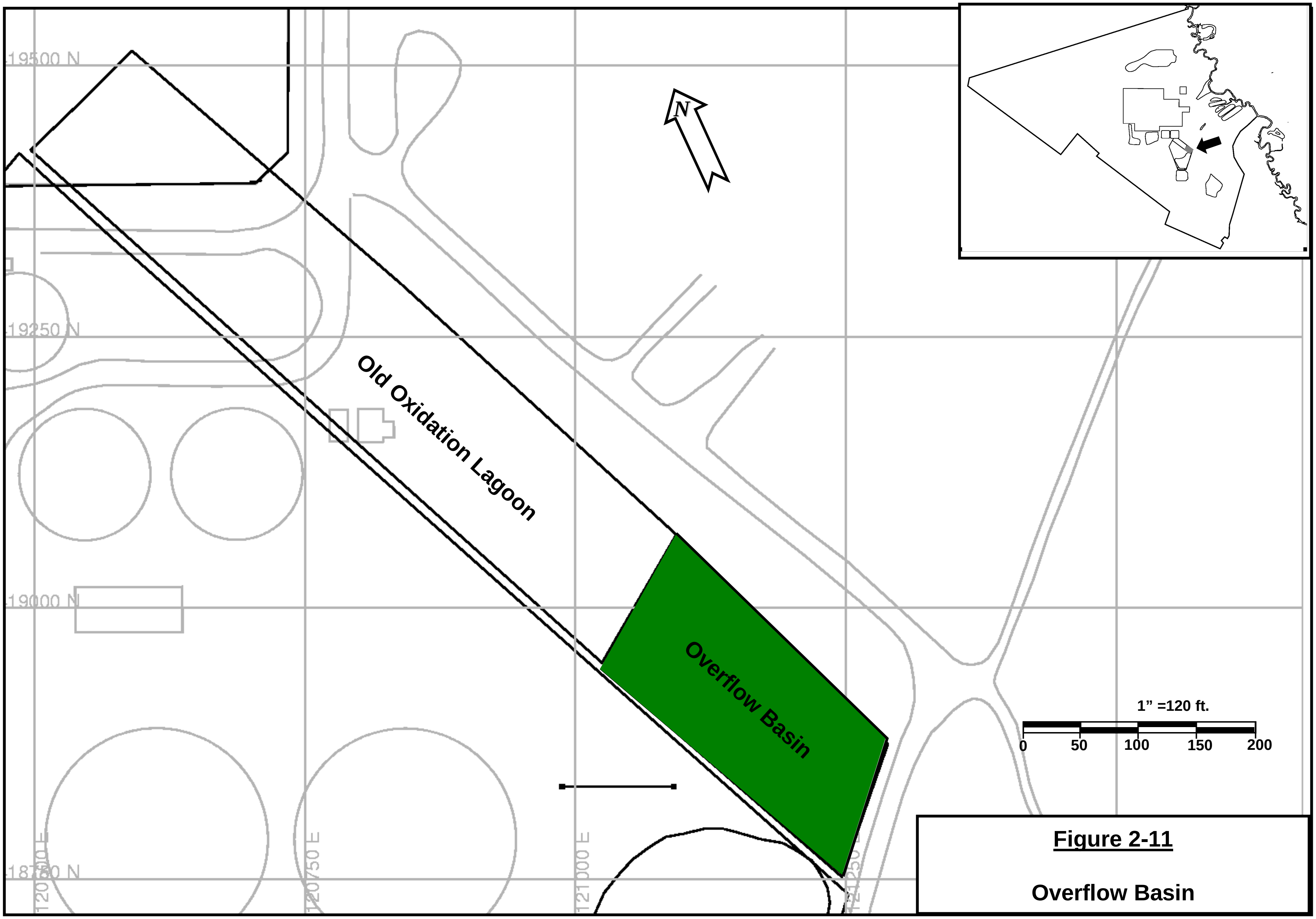


Figure 2-11

Overflow Basin

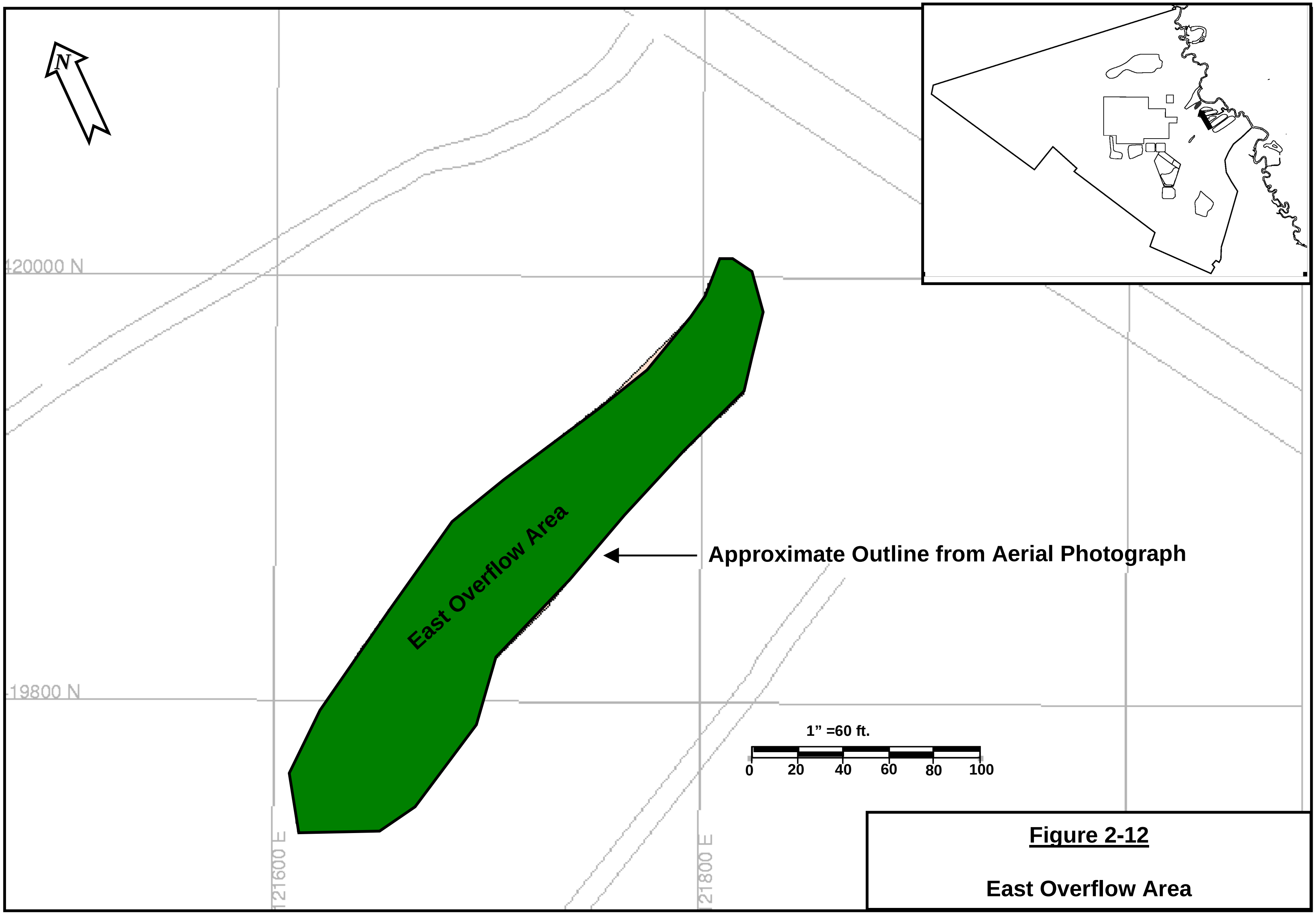


Figure 2-12

East Overflow Area

- Filtercake Disposal Area
- Lime Sludge Disposal Area
- Drum Disposal Area
- Calcium Sulfate Disposal Area
- Borrow/Compactor Area
- Casual Dumping Area

An additional potential source area that Ciba identified after the Source Control RI Report was issued was the Standpipe Burner Area.

The locations of these potential source areas associated with waste disposal activities are shown on Figure 2-13. A physical description and chronology of the disposal history for each of these potential source areas is provided below.

2.2.5.1 Filtercake Disposal Area

The location of the Filtercake Disposal Area, which is approximately ten (10) acres, is shown on Figure 2-14. Also shown on the figure is the Trench Disposal Area, which is a sub area of approximately one (1) acre within the Filtercake Disposal Area. This Filtercake Disposal Area is located east of the Drum Disposal Area and southeast of the Production Area.

The Filtercake Disposal Area was used from 1952 to 1977 for multiple disposal activities. Plant records indicate that it was primarily used for the disposal of wastewater sludges that were removed from wastewater treatment plant impoundments during routine cleanouts and final closures. These impoundments included the Old Settling Basin and the Old Oxidation Lagoon (first generation wastewater treatment plant), the Equalization Basins (first and second generation wastewater treatment plant) and the Northern and Southern Sludge Drying Lagoons of the Backfilled Lagoon Area (second generation wastewater treatment plant) [(NUS 1988a) (Eckenfelder 1993)]. The Trench Disposal Area was used from 1952 to 1960 for the disposal of debris and trash, crushed drummed waste materials and miscellaneous bulk sludges.

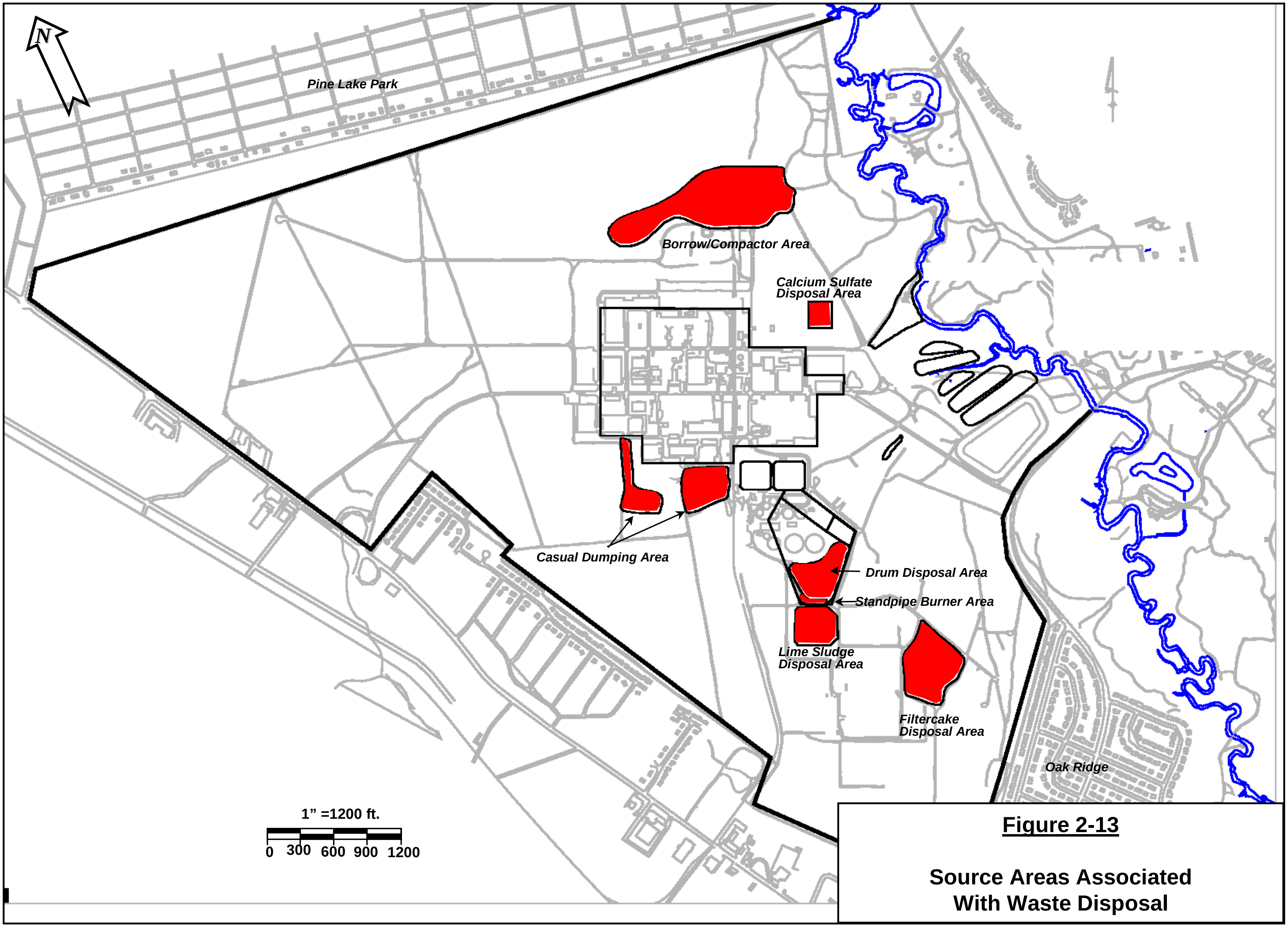


Figure 2-13

Source Areas Associated With Waste Disposal

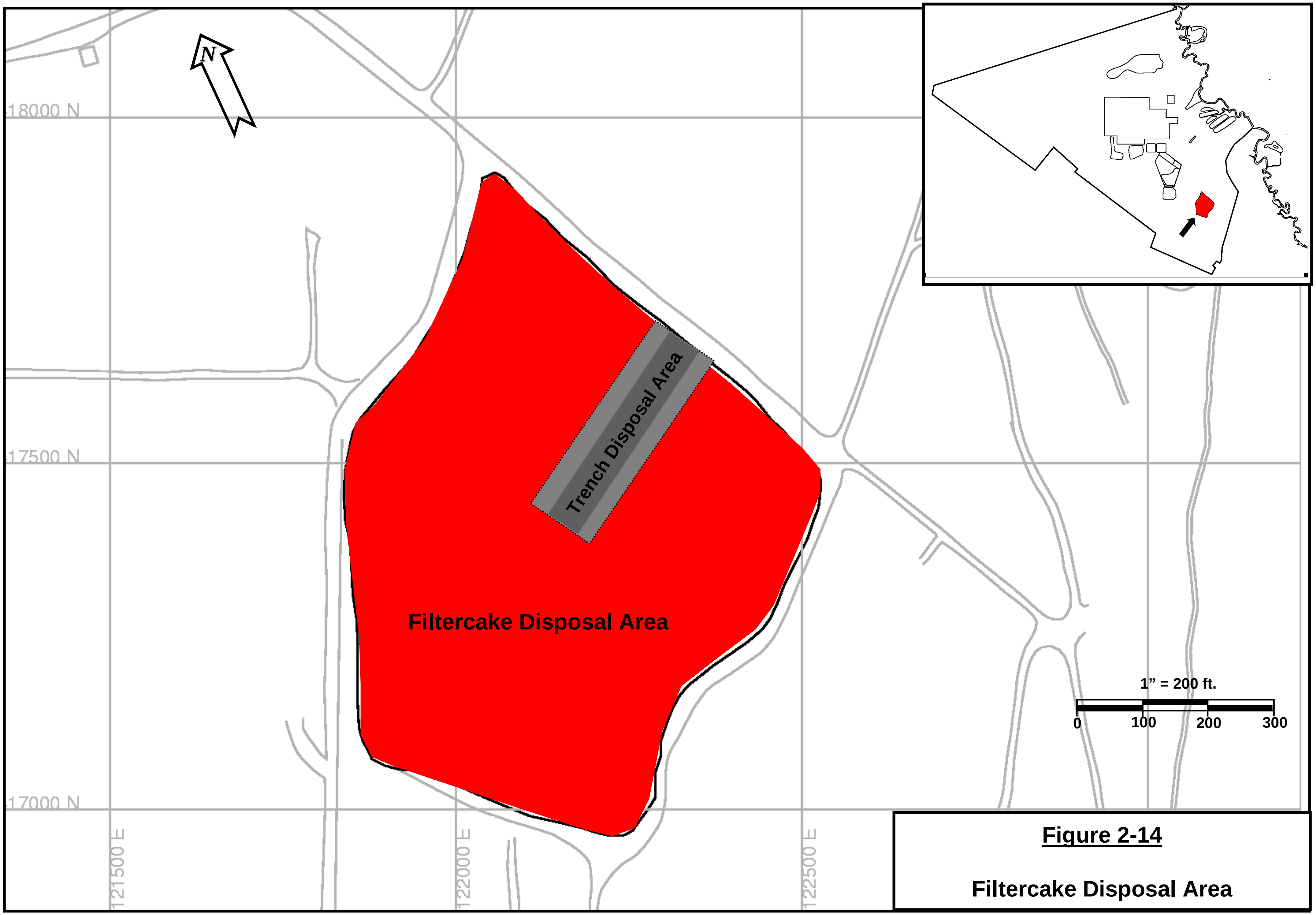


Figure 2-14

Filtercake Disposal Area

After 1977, the Filtercake Disposal Area was no longer used for disposal. Wastewater treatment plant sludge from the third generation wastewater treatment plant was disposed of in the newly constructed Active Landfill. The Filtercake Disposal Area was closed around 1977 by covering the sludge with a layer of soil and grass seeding. No synthetic cap was installed during closure of this area.

The earliest observable evidence of activity in the Filtercake Disposal Area is in a 1956 aerial photograph of the site which reveals a northeast-southwest trench, which appears to have been formed from a natural topographic depression (EPIC 1984). Photographs taken in 1961 and 1962 show that the area around the trench has been cleared of trees and that debris and probable drums are visible in the trench. By 1965, sludge seems to have been deposited randomly in the cleared area but the trench and drums are no longer visible. This activity continued until at least 1976 (EPIC 1984).

2.2.5.2 Lime Sludge Disposal Area

The Lime Sludge Disposal Area is approximately four (4) acres and is comprised of three (3) unlined pits, each about one third of the total area (see Figure 2-15). From 1952 to 1972, these pits were used for disposal of wastes related to the manufacture of anthraquinone compounds from the Building 102 vat dye production. The manufacturing process involved the use of a 75 percent solution of arsenic acid (H_3AsO_4) as an oxidizing agent, resulting in the formation of arsenous acid waste (Ciba 1993). Between 1952 and 1956, the arsenous acid wastes were treated in Building 104 with hydrated lime in order to render the arsenic insoluble by the formation of calcium arsenate (Ca_3AsO_4). Initially, the resulting slurry was filtered and the filtercake was placed in series of three (3) pits within the Lime Sludge Disposal Area. Each pit was filled before the next one was constructed for disposal. Pit Number 1 operated from about 1952 to 1960, Pit Number 2 from 1960 to 1966 and Pit Number 3 from 1967 to 1972.

From mid 1956 until 1963, the limed slurry was pumped directly from Building 104 through heated lines to the Lime Sludge Disposal Area (Pit Numbers 1 and 2). In 1963, the waste treatment process was transferred to the wastewater treatment plant. The untreated filtrate and wash waters were pumped to the wastewater treatment plant where the liming took place. The treated slurry was then transferred from the wastewater treatment plant to Pit Number 2. From 1967 to 1972, the slurry was disposed of in Pit Number 3 (Ciba 1993).

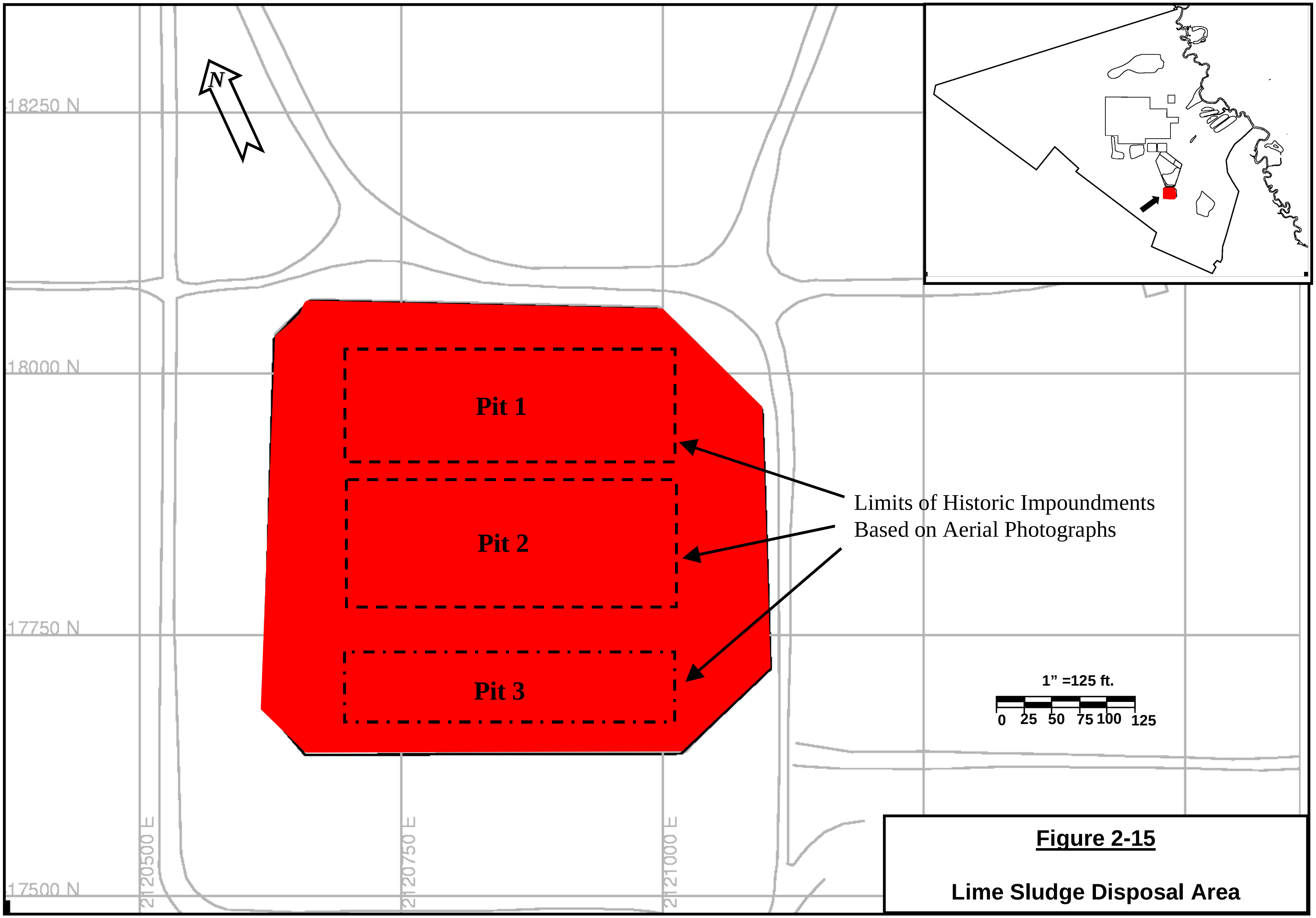


Figure 2-15

Lime Sludge Disposal Area

In 1972, arsenous acid waste ceased to be produced due to a change in the manufacturing process. In 1977, the three (3) pits were treated with weedkiller, and covered with sand, a 30-millimeter PVC membrane, and two feet of topsoil. Paved drainage swales were added to control surface runoff and the area was subsequently seeded.

2.2.5.3 Drum Disposal Area

The Drum Disposal Area is a parcel of land (approximately five (5) acres) located south of the Production Area (see Figure 2-16). The Drum Disposal Area was used for the disposal of solid waste from plant manufacturing activities from about 1960 to 1977. It is located over portions of the Old Settling Basin, which was used in the first generation wastewater treatment process from about 1954 to 1960. As discussed previously, in 1960, the Old Settling Basin (as well as the Old Oxidation Lagoon) was taken out of service as part of the second generation wastewater treatment plant modification. Placement of waste in the Drum Disposal Area/Old Settling Basin coincides with the completion of the major plant expansion for production of azo dyestuffs and plastics and resins (about 1960).

Another activity which took place in the Old Settling Basin after it was decommissioned was the installation of two (2) tee-pee incinerators in the mid 1960s. These units were used to burn normal plant trash, used fiber drums and occasionally waste solvents. In 1970, these units were dismantled and replaced with a trash compactor. In 1976, the compactor was moved to the Borrow Compactor Area (see Section 2.2.4.6).

Waste disposal activities in the Drum Disposal Area/Old Settling Basin went through several phases as the wastewater treatment plant evolved and manufacturing operations at the Facility expanded. Based on the known historical waste disposal chronology and the characteristics of the wastes, three (3) distinct subareas have been identified within the Drum Disposal Area. These subareas are the Non-Intact Drum Area, the Stacked Drum Area and the Iron Filings Area (see Figure 2-16). The Non-Intact Drum Area was used for the disposal of crushed drummed wastes and debris from approximately 1961 to 1972. The Stacked Drum Area operated from 1972 to 1977 and was used for the disposal of intact drums containing various wastes. The Iron Filings Area was used from 1961 to 1977 for the disposal of bulk sludges. The categories of waste materials disposed of in these three (3) subareas are provided in the subsections below.

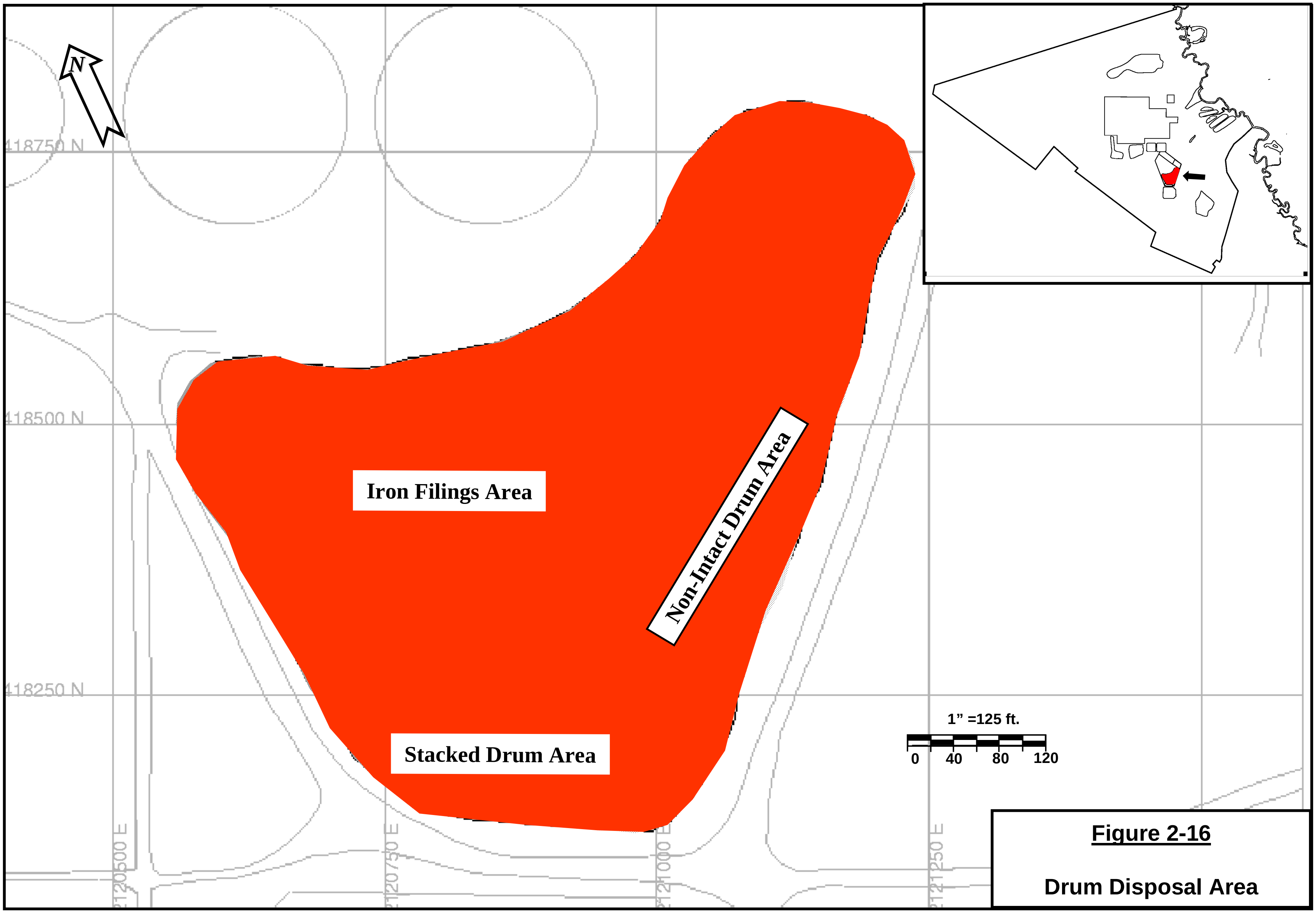


Figure 2-16

Drum Disposal Area

Aerial photographs (EPIC 1984) illustrate the historical changes over the years in the physical appearance of the Old Settling Basin/Drum Disposal Area. A photograph from 1956 shows the Old Settling Basin as operational and nearly full of liquid. Photographs indicate that by 1962, part of the Old Settling Basin was being used for solid waste disposal; at this time it contained mounded material and debris along its perimeter as well as a graded ramp on its northwestern side. A 1965 photograph shows that disposal of debris and mounded material has moved inward from the sides of the Old Settling Basin towards its center. Crushed drums appear to have been disposed of along the southeastern side. Drums are visible again, apparently intact, in the southern portion of the Old Settling Basin in a 1976 photograph. This photograph also shows pockets of sludge and dark material in the central and northwestern part of the Old Settling Basin. Also during 1976, photographs indicated that significant earth-moving activity was being conducted as part of the third generation wastewater treatment plant modification. Part of this activity included excavation of the remaining portion of the Old Settling Basin and subsequent disposal of this material in the Filtercake Disposal Area.

The Drum Disposal Area continued to operate until the Active Landfill was completed and started up in 1977. In 1977-78, all waste disposal activities in the Drum Disposal Area ceased and the area was closed according to an NJDEP-approved closure plan. Closure included the following:

- Placing soil/sand over the waste surface;
- Capping the area with a 30-milliliter PVC liner and a 2 foot layer of soil;
- Installing passive vent pipes for exhaust of any gases generated beneath the cap;
- Seeding the topsoil as an erosion control measure; and
- Installing an asphalt drainage swale around the capped Drum Disposal Area for surface water control.

A 1983 photograph (EPIC 1984) shows that the northern and western portions of the Old Settling Basin were built over with the buildings and tanks of the present wastewater treatment plant. The southern and eastern sections, which are now known as the Drum Disposal Area, had been capped and runoff swales constructed along the border. The extent of the Drum Disposal Area is easily ascertained from the 1983 photograph.

As stated previously, the Drum Disposal Area was used for the disposal of solid waste from production activities (i.e., the manufacture of azo dyestuffs, plastics and resins). During the operation of the Drum

Disposal Area, most liquid waste from these manufacturing activities was processed through the wastewater treatment plant. Some specific wastestreams (i.e., spent solvents) were also disposed of in the tee-pee incinerator, the Standpipe Burner Area (see Section 2.2.4.4), or were shipped off-site for disposal.

The waste disposal histories and waste categories for the (3) subareas of the Drum Disposal Area (the Non-Intact Drum Area, the Stacked Drum Area and the Iron Filings Area) are summarized below. This information is based on the historical plant documentation referenced in the Source Control RI Report (CDM 1994a) and the Drum Disposal Area Test Pit Program Report (Engineering Science 1993a). The latter was a supplemental investigation to the Source Control RI.

- Non-Intact Drum Area

The Non-Intact Drum Area, which is approximately two (2) acres, is located in the eastern part of the Drum Disposal Area (see Figure 2-16). This area, which was referred to as the "Chemical Bury Dump" in plant documentation, was used for the disposal of drummed wastes and debris from approximately 1961 to 1972. Prior to disposal, the drums were crushed by heavy equipment to compact wastes and the wastes were buried in trenches.

As referenced in the Source Control RI Report (CDM 1994a), historical plant documentation, although limited, indicates that some of the materials disposed of in this area included resin filter papers, anthraquinone (AQ) soot and pulverized glass.

- Stacked Drum Area

The Stacked Drum Area is located in the southern central part of the Drum Disposal Area (see Figure 2-16). This area, which is about one (1) acre, was used for the disposal of drummed wastes and debris from 1972 to 1977. Drums containing waste were disposed of in intact condition. The intact 55-gallon light gauge steel drums were stacked upright in layers in segregated cells. Each layer of stacked drums was reportedly covered with sand, with as many as four layers of drums per cell. Based on the results of the Source Control RI, there are an estimated 33,600 intact drums present in the Stacked Drum Area, which corresponds to about 6,700 tons of drummed waste. This volume is based on estimated total area of 5,400 yd^2, and assumes that 100% of the area contains three (3) tiers of drums (CDM 1994a).

In 1971, the plant began keeping records called "E-149 forms" which documented the waste disposed of in the Drum Disposal Area. The E-149 forms represented an early version of the manifest system currently required under RCRA for hazardous wastes. Information provided on the E-149 form included the date, waste description, indication of waste quantity, and place of waste disposal. While this information does not provide a detailed chemical characterization of the wastes, it does provide insight as to the overall waste categories and quantities of waste disposed of in the Stacked Drum Area, as well as the Iron Filings Area. A summary of the information provided in the E-149 forms can be found in the Source Control RI Report (CDM 1994a).

Based on the summary of the E-149 forms, the following four (4) primary categories of drummed waste were disposed of in the Stacked Drum Area 1971 and 1978:

1. Epoxy resins/resin residues (approximately 3,120 tons). These materials were generated from filtration and clarification processes utilized during the manufacture of epoxy resin products. These include filter paper, filter cartridges, clay, and diatomaceous earth. Further, it is estimated that 2,424 tons of the total 3,120 tons were sparkler salt, which consists of wet diatomaceous earth with solvent and/or resin.

2. Clarification residues (approximately 1,259 tons). These were process residues or cakes resulting from the dye and pigment clarification process.

3. Distillation residues (approximately 1,326 tons). These were solid materials remaining after the distillation of solvent media from various manufacturing processes.

4. Miscellaneous materials, (approximately 852 tons). These included lab waste, concrete/brick, anthraquinone (AQ) soot and miscellaneous process residues.

The total tons from these four (4) categories is approximately 6,600 tons of drummed waste, which corresponds to about 33,000 drums.

During the 1992 test pit investigation (Engineering Science 1993a), a total of 315 drums were removed from six test pits in the Stacked Drum Area. The test pits contained from one to four layers of stacked drums. Only intact drums were encountered; no non-intact or non-drummed wastes were found in any of the test pits. The majority of the drums exposed and removed were in good condition. In general, the categories of waste materials found in the drums were in agreement with categories listed above from the E-149 forms. For example, the primary category of material found in the drums was epoxy resins/resin residues, with sparkler salts comprising the largest percentage of the category.

Based on the results of the test pit investigation, there are an estimated 31,000 drums (or 6,200 tons of drummed waste) in the Stacked Drum Area. This volume is based on an estimated total area of 4,200 yd^2, and assumes that 75% of the area contains four (4) tiers of drums and 25% of the area contains one (1) tier of drums (Engineering Science, 1993a).

➢ <u>Iron Filings Area</u>

The Iron Filings Area, or "Iron Oxide Area" as it was historically known, is located in the northern part of the Drum Disposal Area (see Figure 2-16). This area is about 1.5 acres and operated from about 1961 to 1977. Historical plant records indicate that this area was used primarily for the disposal of bulk iron oxide sludge from the manufacture of dyestuffs in the North Dye Area. From 1971 to 1977, an estimated 2,348 tons of bulk iron sludge was disposed of in the Iron Filings Area (based on the summary of the E-149 forms). Other process residue and miscellaneous materials disposed of in the Iron Filings Area included anthraquinone (AQ) catalyst, calcium sulfate sludge, coal ash, and press cloth.

2.2.5.4 Standpipe Burner Area

The Standpipe Burner Area, which is approximately 0.5 acres, partially overlaps the southern boundary of the Drum Disposal Area (see Figure 2-17), according to historical site photographs and maps. Due to its close proximity to the Drum Disposal Area, it is difficult to differentiate the northern border of the Standpipe Burner Area from the southern border of the Drum Disposal Area.

Historical plant records indicate that as much as 200 to 250 gallons per week of laboratory solvents and solvent contaminated laboratory wastes (i.e, reaction sludges) that could be poured into lab solvent waste cans were disposed of in the concrete pipes of the Standpipe Burner Area between 1959 and 1970. Plant disposal protocol dictated that the laboratory materials be poured into the concrete pipes and then an ignition source (lighted paper) was put into the pipes. The intent was to incinerate the waste within the concrete pipes; however, anecdotal information indicates that sometimes the waste materials did not ignite.

This area was not investigated during the 1994 Source Control RI since it was not identified as a potential source area until after the RI was completed. The Standpipe Burner Area was investigated in 1994 and 1995 during the Non Aqueous Phase Liquid (NAPL) Field Investigation (Ciba 1998a) and also in 1997 and 1998 during the supplemental source area field investigation (see Appendix A of this report).

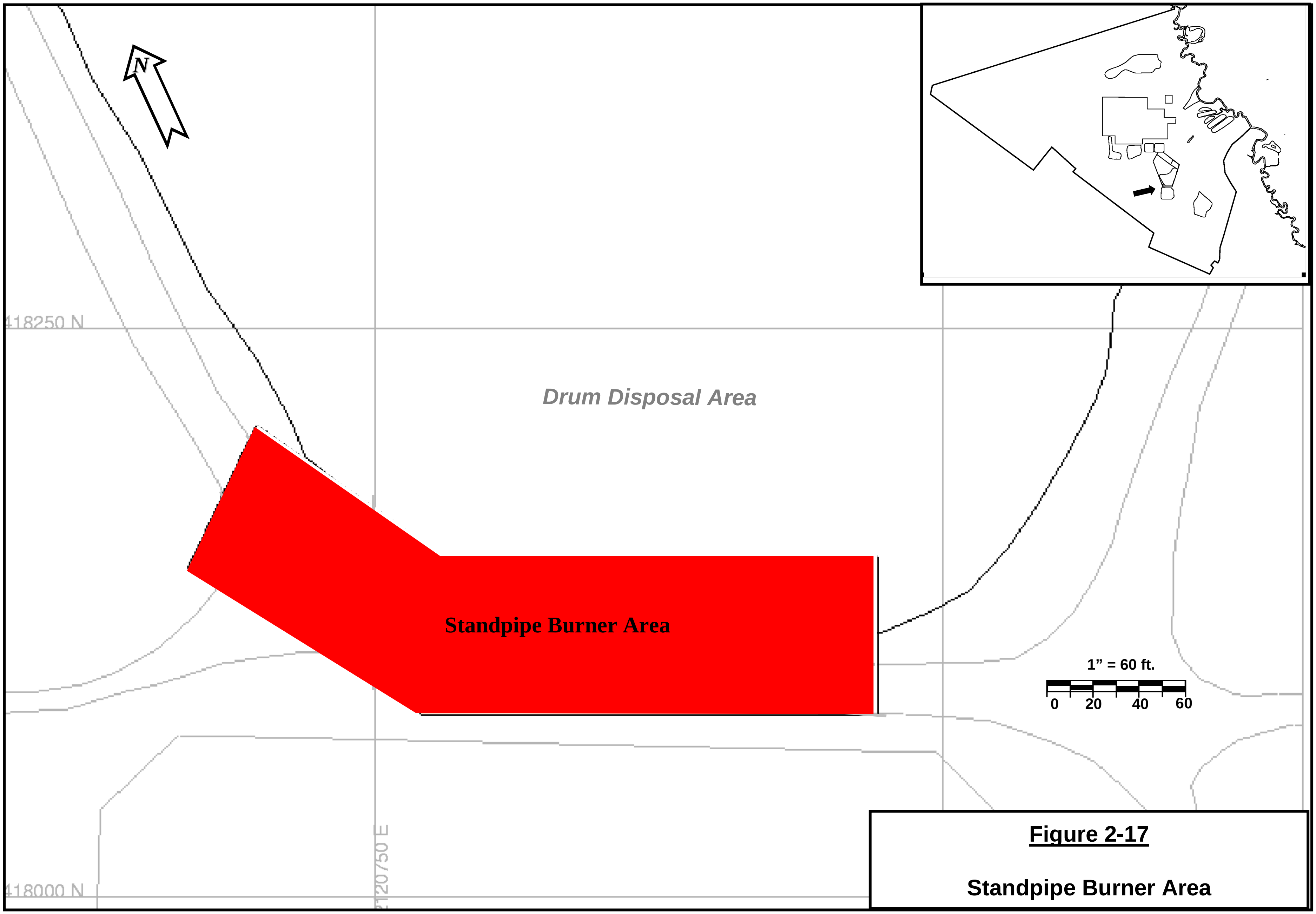


Figure 2-17

Standpipe Burner Area

The characterization data from these investigations is discussed in Section 3.0 of this report (“Site Characterization”).

2.2.5.5 Calcium Sulfate Disposal Area

The Calcium Sulfate Disposal Area is located just east of the northeast corner of the Production Area (Figure 2-18). It was used from 1960 until the early 1980s as a repository for neutralized sulfuric acid residue from the production of metanilic acid, a product manufactured in Building 307 of the North Dye Area. During the synthesis of metanilic acid, large excesses of sulfuric acid were neutralized by the addition of limestone. The resulting insoluble “calcium sulfate sludge” was filtered off and washed with water. The remaining sludge was reslurried in water and discharged through an underground pipe to a pit within the Calcium Sulfate Disposal Area (Ciba 1993). Historical plant records indicate that periodically this pit was dug out and the dried sludge was transferred to the Drum Disposal Area (Iron Filings Area).

A 1962 aerial photograph (EPIC 1984) shows a faint pit in a clearing although neither the dimensions of the pit or any disposed material can be identified. The Calcium Sulfate Disposal Area's appearance is again vague in 1965 and 1976 photographs, although EPIC described the pit as possibly containing liquid. By 1983, the pit and surrounding area appear as a dark, square shape, approximately 120 feet on each side. The dark color is likely due to a ten (10) foot coal pile which was deposited in this area (NJDEPE 1990).

2.2.5.6 Borrow Compactor Area

The Borrow/Compactor Area is located to the north of the Production Area (Figure 2-19). This area was historically used as a source of fill material and a repository for construction debris beginning in 1952. It encompasses approximately twenty-five (25) acres and based on its physical features it is divided into three subareas: the upper, lower and western areas. A bluff separates the upper and lower areas.

From the late 1970s to 1981, the Borrow Area was used as a staging area for drummed waste which was shipped off-site for disposal. Through the 1980s, it was used as a staging area for empty drums which were shipped off-site to a recycling facility. In 1976, a trash compactor was operating on the eastern edge of the upper area. Historical plant records show that nonhazardous plant refuse, including construction debris, was compacted at this location, although there is a possibility that some material containing residual waste was disposed of here as well (NUS 1988a). Historical photographs (EPIC

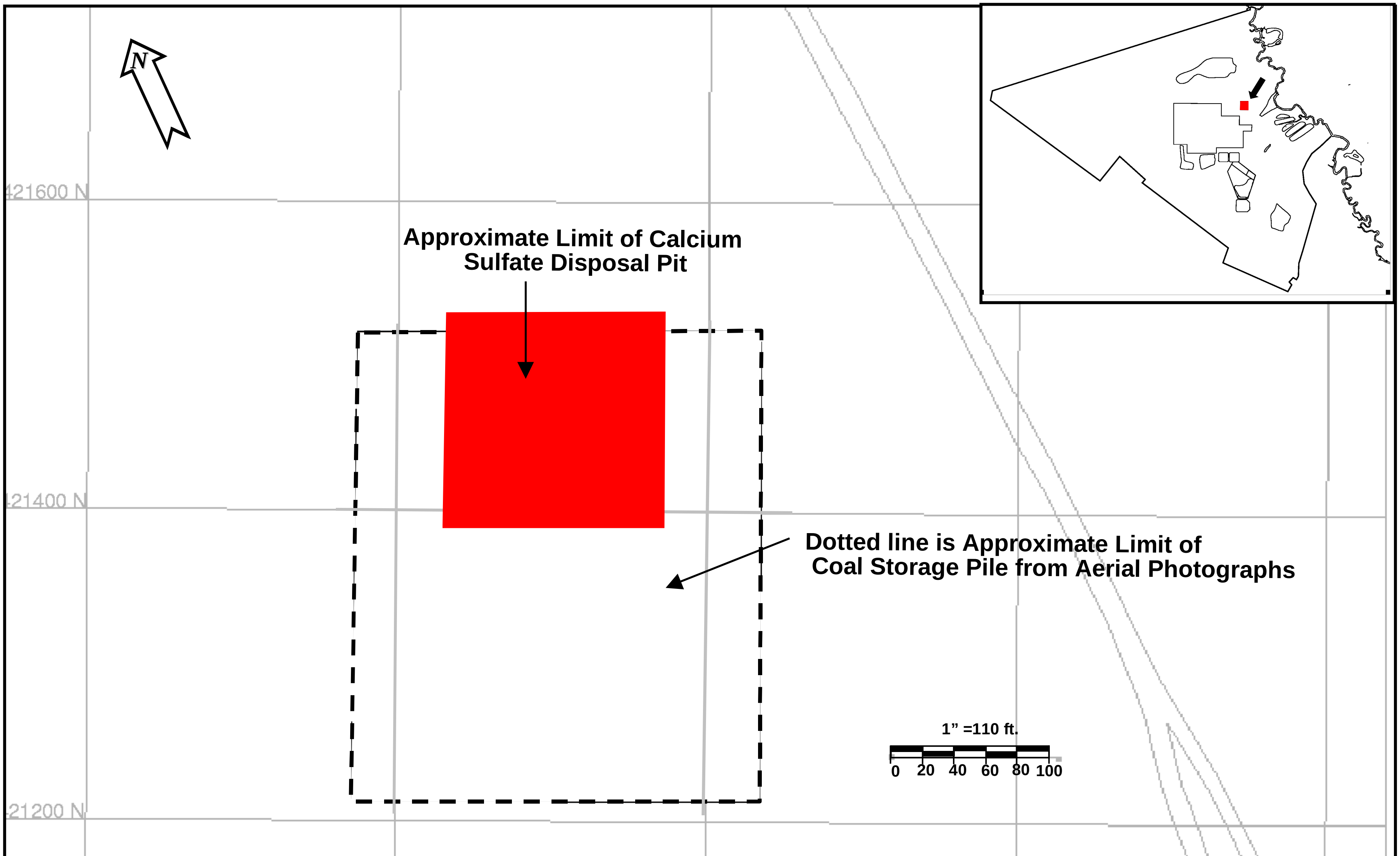


Figure 2-18

Calcium Sulfate Disposal Area

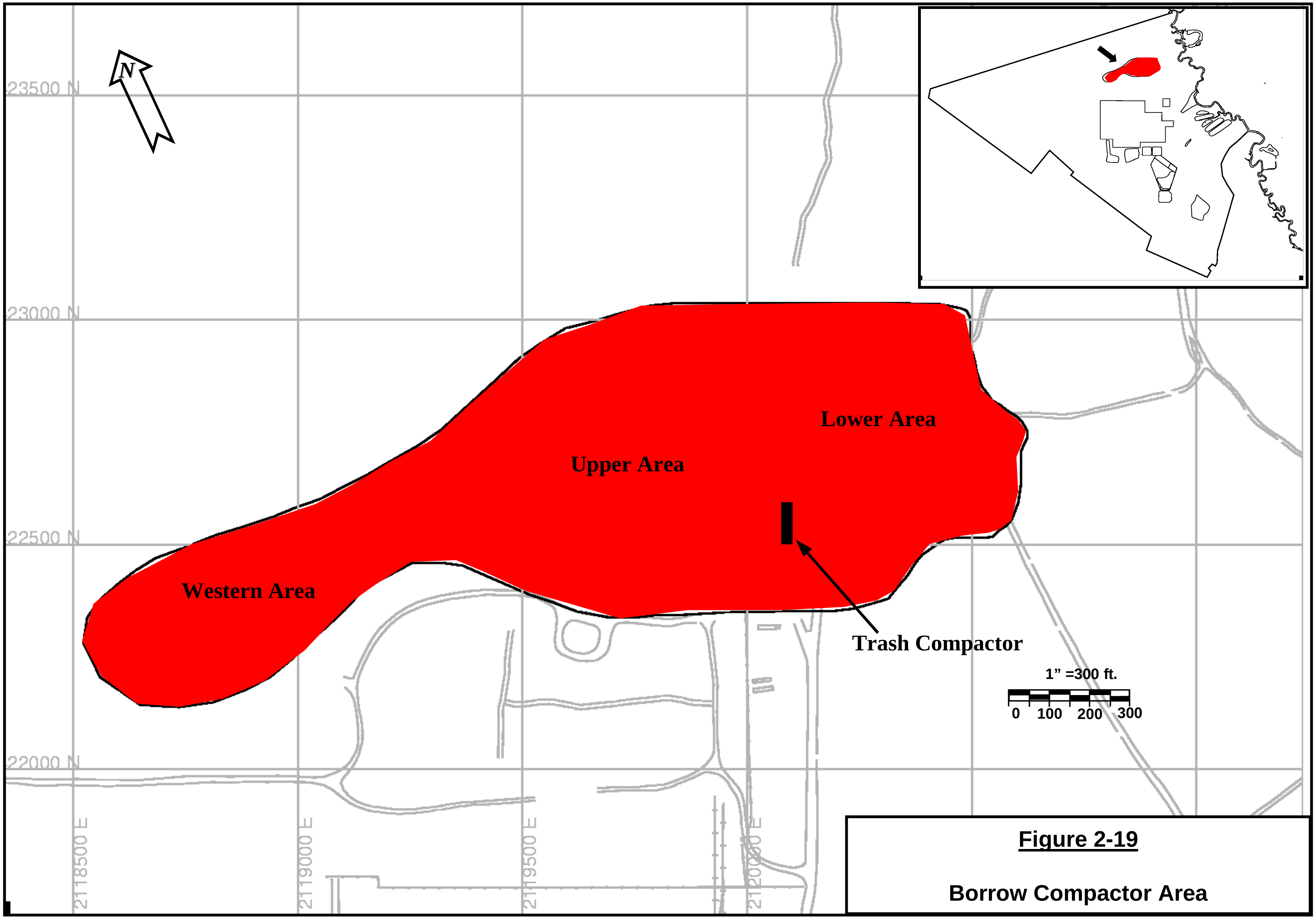


Figure 2-19

Borrow Compactor Area

1984) indicated the possibility of drum disposal and ground staining in the northern half of the upper area.

2.2.5.7 Casual Dumping Area

The Casual Dumping Area, which comprised about three (3) acres, is located in a heavily wooded area south of the central portion of the former Production Area (Figure 2-20). This area appears to have been cleared of vegetation based on aerial photographs from the late 1950s to the 1960s and may have been used for debris and trash disposal during this time. Limited historical plant information indicates that the Casual Dumping Area, referred to as the “trash landfill,” was used for debris and trash disposal in the early 1970s until the trash compactor was constructed in the Borrow Compactor Area (approximately 1975). No evidence has been found that the Casual Dumping Area was ever used for waste disposal (Eckenfelder 1993).

In a 1951 photograph a small drainage feature, which appeared to be naturally occurring, was noted extending approximately 350 feet from the Production Area’s southwest corner. A 1956 photograph shows that in addition to this historic drainage, a large "linear drainage trench" had been constructed; no liquid is discernable within it. Although no disposal areas can be identified in the 1956 photograph, it is clear that activity had occurred in the Casual Dumping Area. Ground staining was noted based on photographs from 1962 and 1965 in the vicinity of the trench. By 1976, only a clearing adjacent to the trench is still visible. Activity in the Casual Dumping Area apparently ceased by 1983 because although the "linear drainage trench" is still evident, the area is partly overgrown with trees.

During the Source Control RI, no evidence of waste disposal was observed in the "linear drainage trench" and its associated clearing. A drainage pipe was noted at the northern end of the trench originating from the Production Area. This pipeline would most likely have been constructed for surface water runoff, since process water from the Production Area (wastewater) was historically sent to the wastewater treatment plant. A second clearing identified in the aerial photographs adjacent to the perimeter fence contained large mounds of soil with intermixed debris. Scattered drum fragments were also noted on the ground surface.

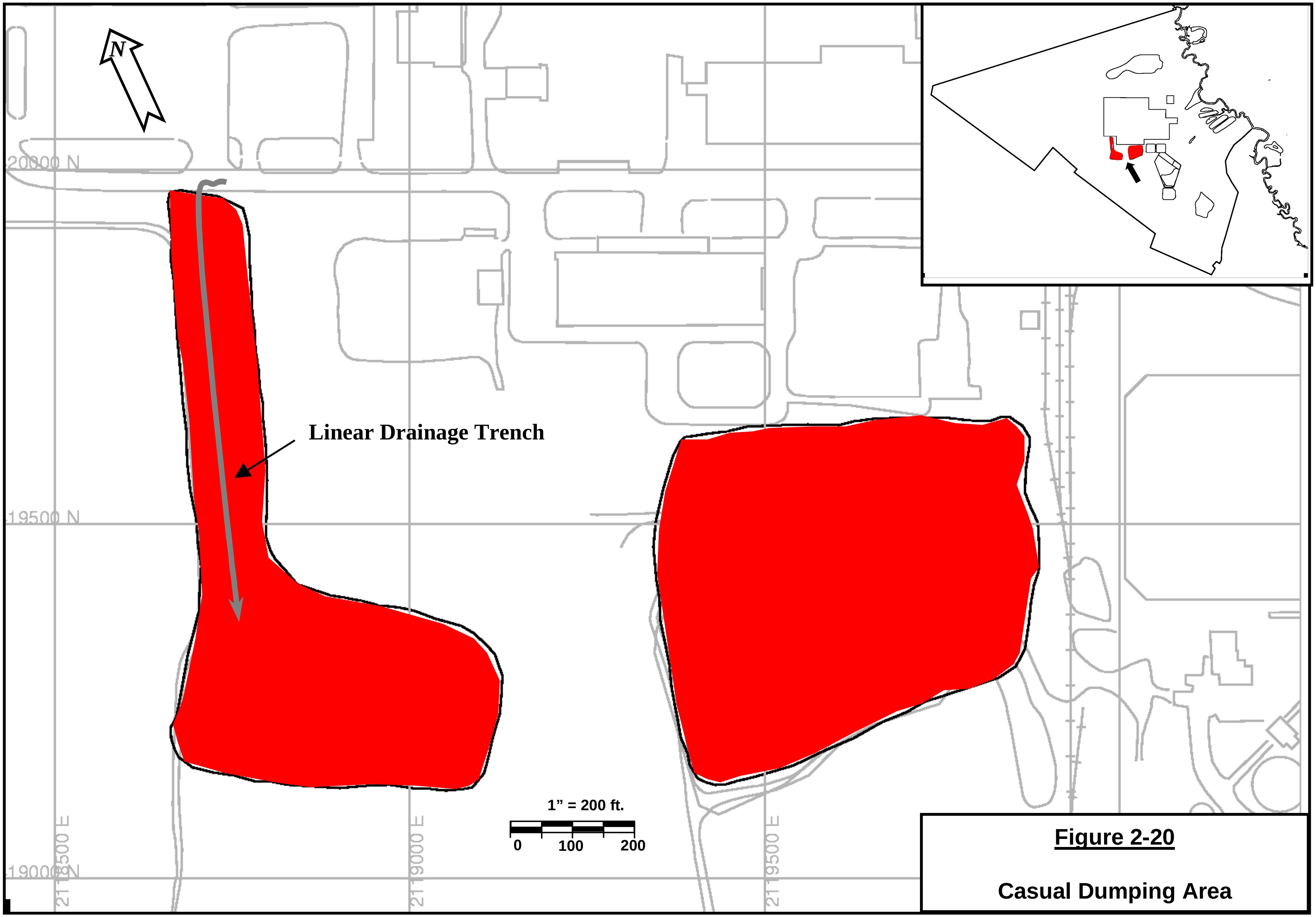


Figure 2-20

Casual Dumping Area

2.2.6 POTENTIAL SOURCE AREAS ASSOCIATED WITH PRODUCTION-RELATED ACTIVITIES

The two (2) production-related potential source areas that were identified in the Source Control RI Report (CDM 1994a) are the following:

- Production Area
- Fire Training Prevention Area

The locations of these potential source areas are shown on Figure 2-21. A physical description and chronology of the history of these potential source areas is provided below.

2.2.6.1 Production Area

As discussed in Section 2.2.2, the Production Area refers to that portion of the plant used for chemical manufacturing activities beginning in 1952. It is a relatively flat area, which was covered by numerous buildings, underground, and aboveground tanks, piping, roads and parking areas. The major production facilities that comprised the Production Area were the South Dye Area, the Plastics and Additives Area, the North Dye Area and Dye Standardization. The South Dye Area (Buildings 102, 103, 104 and 105), which produced anthraquinone-based dyestuffs and pigments, operated from 1952 to 1984. Epoxy resins, additives, stabilizers and specialty pigments were manufactured in Buildings 108 and 109 from 1960 to 1990. The North Dye Area manufactured azo-based dyestuffs and intermediates from to 1960 to 1988. In the 1960s, dye standardization operations began in Buildings 51/51A and were terminated in 1996. Currently, all of the buildings that were associated with production activities have been demolished, except for warehouse Building 105, which is a now repository for site documents. Additionally, all Underground Storage Tanks (USTs) and associated piping in the Production Area have been removed.

The Source Area RI Report (CDM 1994a) identified the former Production Area as a potential source area based on these production-related activities. Contamination in this area is attributed to inadvertent discharges from manufacturing operations, such as bulk chemical storage, bulk fuel storage, and/or leakage or spillage from operations or damaged sewer lines. There were no identified solid waste disposal areas within the Production Area.

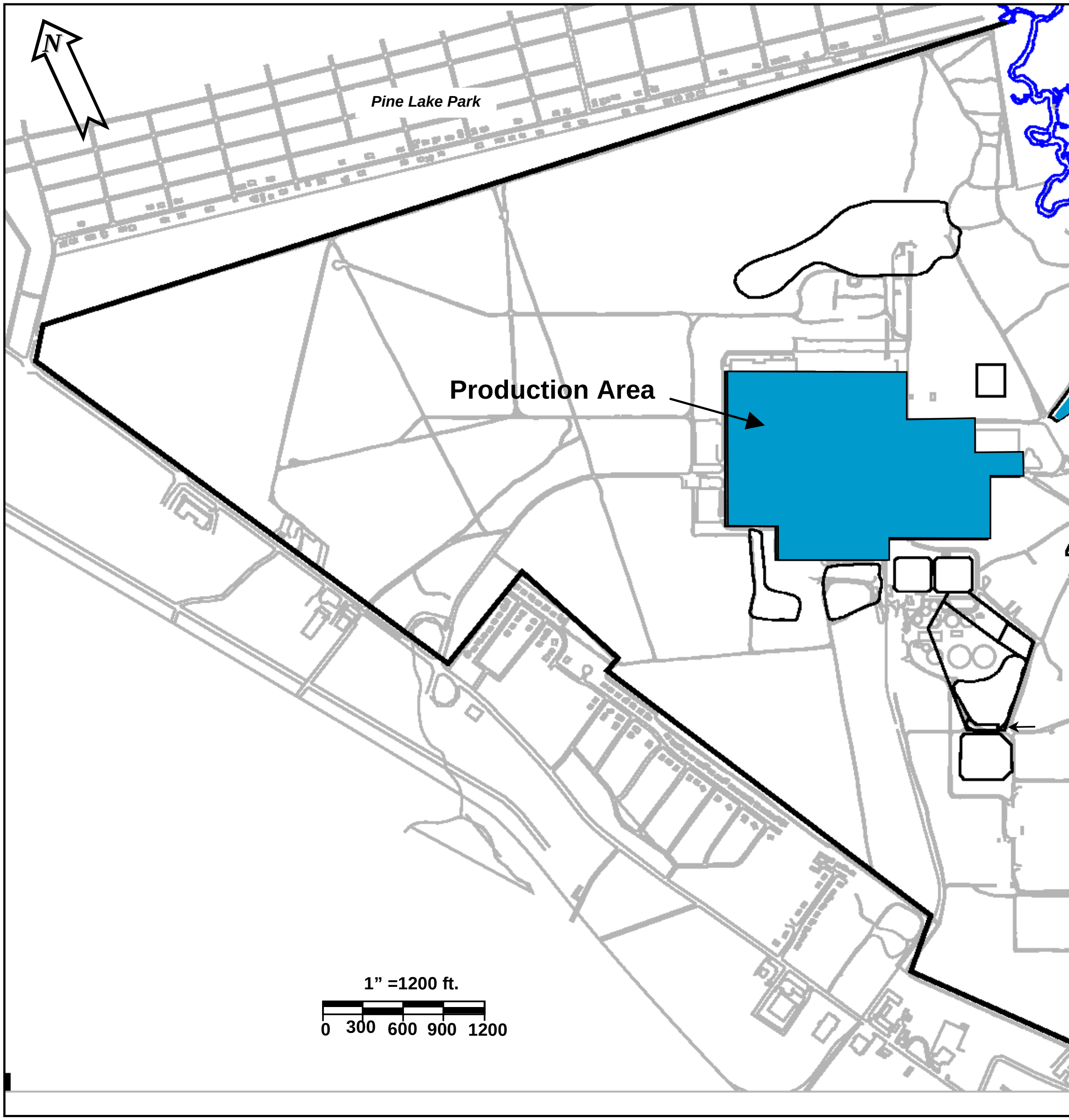


Figure 2-21

Source Areas Associated With Production Activities

Subsequent field investigations [(Ciba 1998a) (Ciba 1998b)] later confirmed that two (2) localized areas within the Production Area are potential source areas which may contribute to groundwater contamination. These areas are the former South Dye Area and the former Building 108/Underground Storage Tank (UST) Area. The locations of these potential source areas is shown on Figure 2-22.

2.2.6.2 Fire Prevention Training Area

The Fire Prevention Training Area is located east of the Production Area, adjacent to the Toms River (Figure 2-23). Fire fighting training activities were conducted within this area. These activities included the controlled ignition of solvents and other chemicals in order to simulate potential fire situations in the production facilities. Oils and solvents were reportedly burned in kettles as part of fire prevention training exercises (AWARE 1986).

Historical aerial photographs (EPIC 1984) first show activity in the area of the Fire Prevention Training Area in 1965. A large cleared area and a pump house in the northern portion of this area were present. No evidence of burning activities is visible and it is possible that the area was only used for the pump house at this time. In 1976, the Fire Prevention Training Area was similar in appearance except for "standing liquid" near the pump house and very small pits on the northeastern edge. A 1983 photograph again reveals no training related activities in the cleared area of the Fire Prevention Training Area.

2.2.7 SECONDARY SOURCE AREAS

2.2.7.1 Marshland Area

The Marshland Area consists of two (2) separate areas along the Toms River (see Figure 2-24). The “Northern Area" is located across the river, opposite the Fire Prevention Training Area. The “Southern Area" is located across Oak Ridge Parkway from the Facility, northeast of the Cardinal Drive residential area in Winding River Park.

There are no indications that the Marshland Area, which is outside the Facility property boundary, was ever used for waste disposal. The Marshland Area was included as a potential source area in the Source Control RI because it is a natural discharge point for contaminated groundwater leaving the Facility, as evidenced by previous sampling conducted in the two areas.

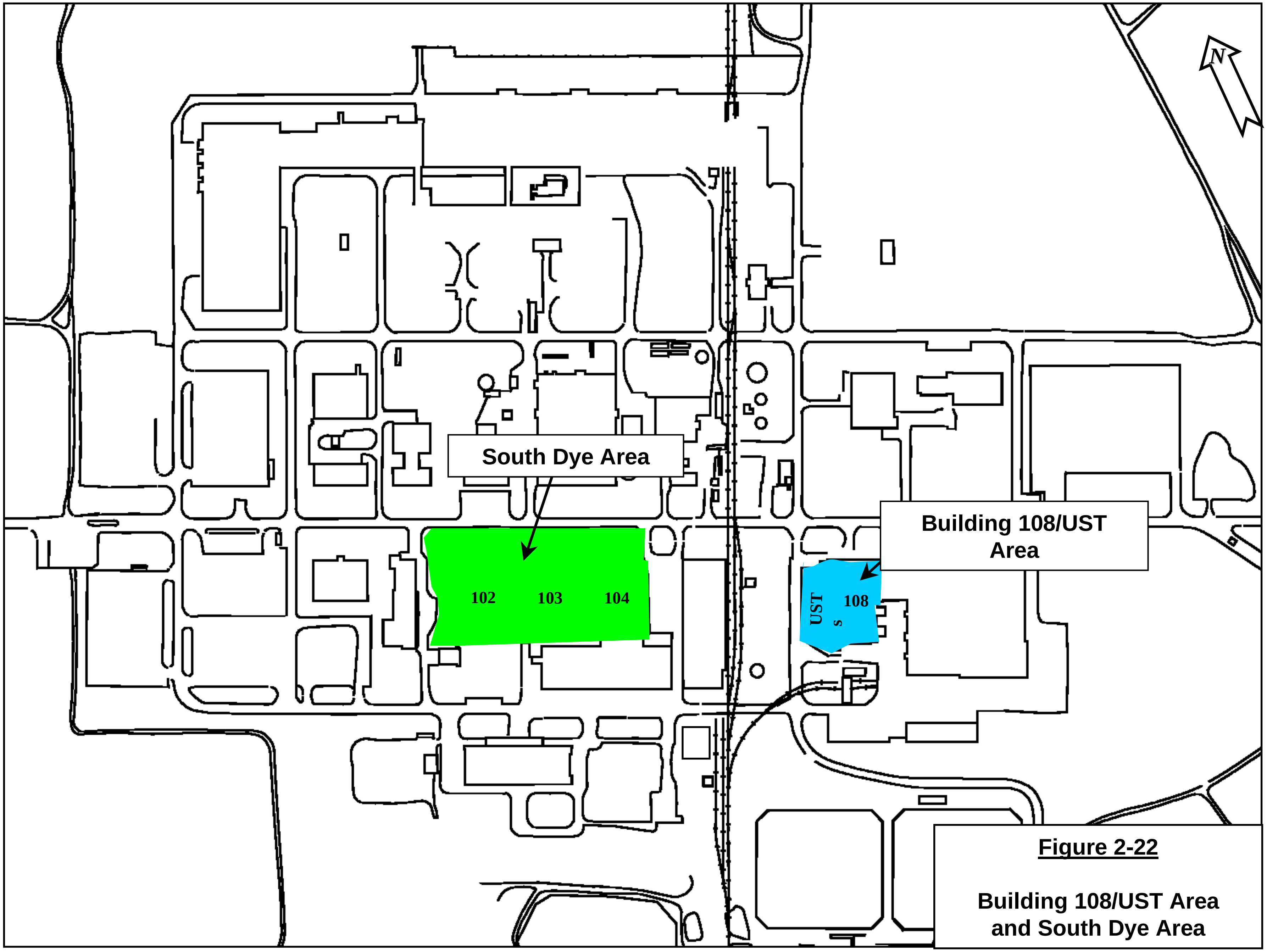


Figure 2-22

Building 108/UST Area and South Dye Area

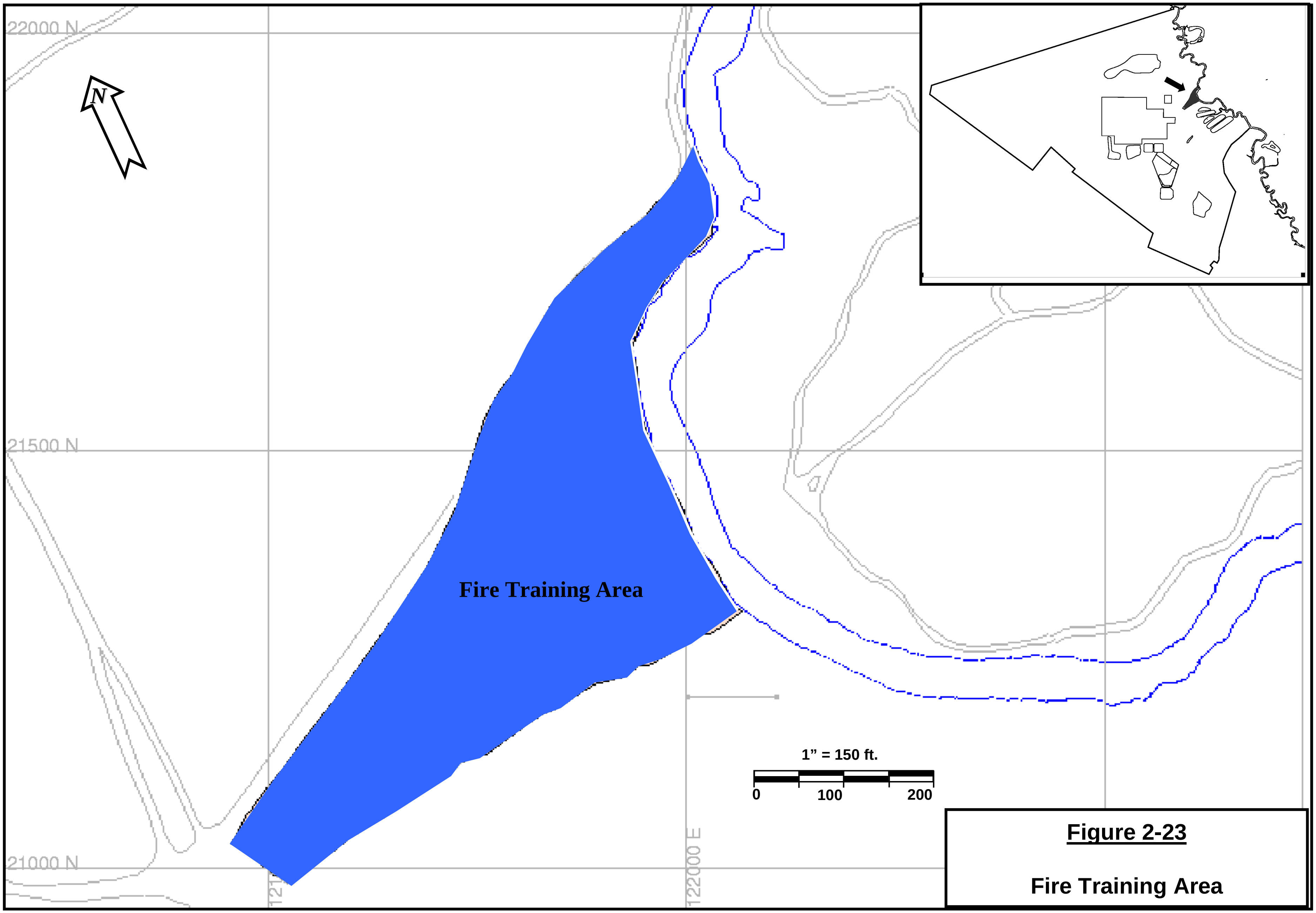


Figure 2-23

Fire Training Area

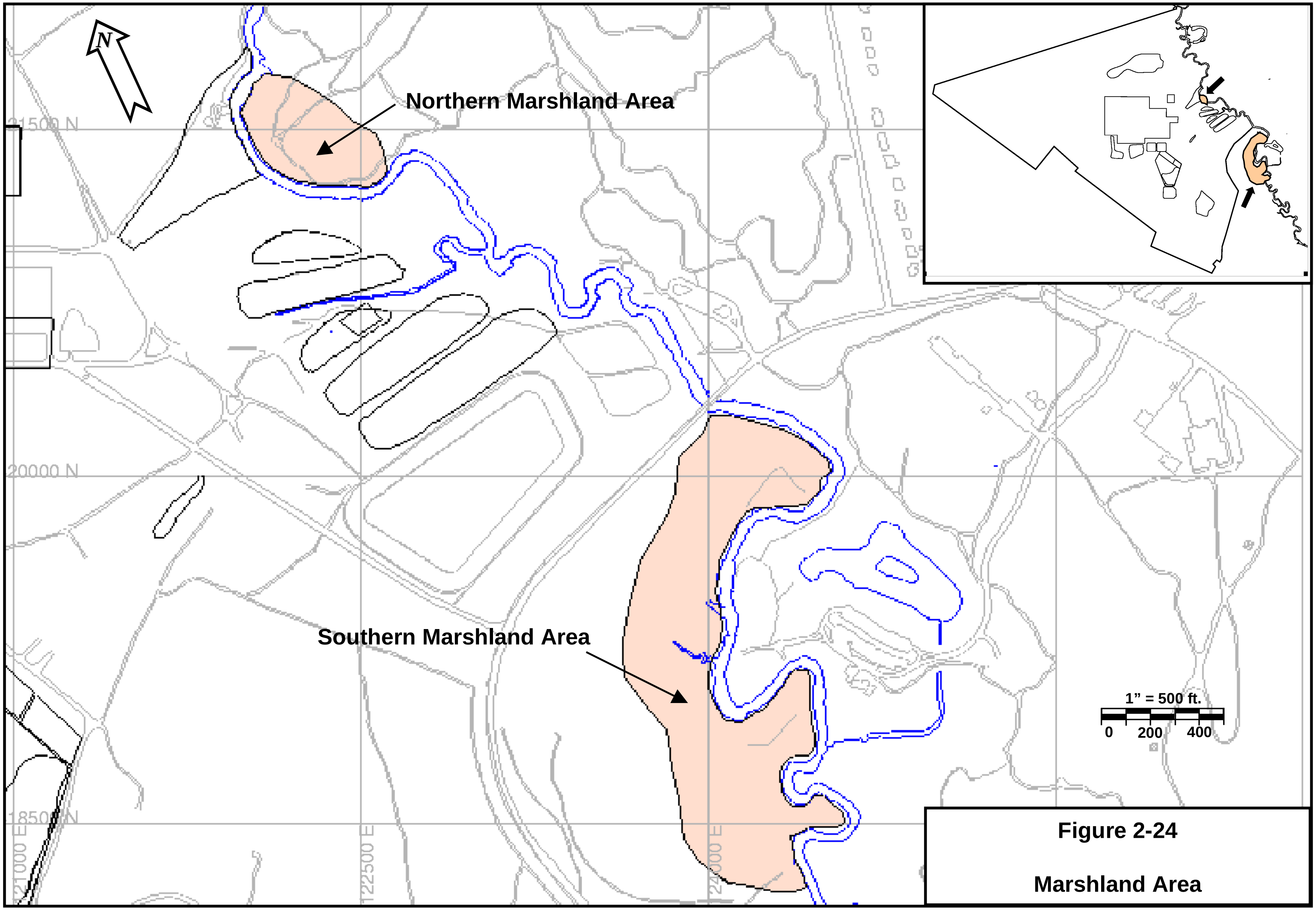


Figure 2-24

Marshland Area

2.3 Regulatory History

As discussed in Section 1.0, the past industrial operations, wastewater treatment and disposal practices have resulted in the contamination of soil and groundwater in areas of the Facility. Remedial activities to address the site-related contamination are regulated under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments Reauthorization Act of 1986 (SARA).

EPA completed an Identification and Preliminary Assessment Report for the Facility in 1980 and the Facility was placed on the CERCLA National Priorities List (NPL) in 1983. The Ciba-Geigy Superfund Site, which is the focus of this FS Report, is herein referred to as the "Site." In 1985, EPA began a Remedial Investigation (RI) of the Facility to 1) characterize the extent of site-related contamination; 2) identify off-site contamination and its impact on public health and the environment; and 3) determine the need for remediation of the Site. The results of the investigation were first released to the public in 1986 and were finalized in the initial RI Report for the Facility (NUS 1988a). The RI Report concluded that contaminant source areas on-site have resulted in groundwater contamination in the Upper Sand Aquifer underlying the Site. Based on the results of this investigation, EPA defined the following operable units at the Site:

- Operable Unit 1 - pertaining to groundwater; and
- Operable Unit 2 - pertaining to known or suspected source areas.

EPA focused on identifying a remedy for groundwater contamination (Operable Unit 1) first as part of a multi-phase remedy for the Site. This decision was made because the nature and extent of groundwater contamination was better understood and implementation of a groundwater remedy would address potential public health concerns by preventing further off-site migration of groundwater. Although a number of the potential source areas were identified as part of the 1988 RI, remedy selection for the potential source areas (Operable Unit 2) was deferred until the nature and extent of contamination could be more fully understood.

A summary of the regulatory history for Operable Unit 1 and 2 is provided in the following subsections.

2.3.1 OPERABLE UNIT 1

2.3.1.1 Record of Decision

After completion of the initial Facility RI (NUS 1988a), which characterized the nature and extent of the contaminated groundwater plume, EPA conducted a Feasibility Study (FS) to evaluate alternatives for the remediation of contaminated groundwater. In 1988, EPA released the draft FS Report for public comment (NUS 1988b). In 1989, following the public comment period, EPA issued Record of Decision (ROD) (EPA 1994, Appendix A) for OU-1 describing the selected groundwater remedy.

As stated in the ROD, the major objectives of the groundwater remedy are protection of human health and the environment and restoration of the Upper Sand Aquifer (and, if necessary, the Lower Sand Aquifer) to drinking water standards. The major components of the groundwater remedy described in the ROD were the following:

- Sealing of contaminated irrigation wells in the vicinity of the contaminated groundwater to prevent future potential human exposure (note that no affected residential drinking water wells were identified in the impacted area);
- Installation of an extraction well system on and off-site to prevent migration of contaminated groundwater beyond the property line and to capture the contaminated groundwater in the off-site areas;
- After extraction, treatment of the contaminated groundwater on-site; and
- Discharge of the treated groundwater to the Toms River.

In accordance with the ROD, the irrigation wells in the vicinity of the contaminated groundwater were decommissioned and well restrictions (based on Ocean County Board of Heath regulations) were imposed that prevent future installation of domestic wells in the area. Prior to its installation, the requirements for the groundwater extraction and treatment remedy were subsequently modified, as discussed in the next section.

2.3.1.2 Explanation Of Significant Differences

After issuance of the ROD, public opposition to the proposed discharge to the Toms River resulted in continued investigation to develop an alternate discharge point for treated groundwater. In 1992, a proposal for recharging the treated groundwater on the Site was submitted by Ciba to EPA. In 1993, after technical review of the recharge proposal (and with broad public support), EPA subsequently modified the ROD groundwater discharge requirement in an Explanation of Significant Differences (ESD) (EPA 1994, Appendix D). The ESD changed the method of discharge of treated groundwater from the Toms River to on-site recharge of treated groundwater to the Upper Sand Aquifer underlying the Site.

The ESD also updated several of the cleanup standards for aquifer restoration. The original standards for aquifer restoration are provided in Tables 5 and 6 of the ROD (EPA 1994, Appendix A). Chemical-specific drinking water standards, referred to as Maximum Contaminant Levels (MCLs), are listed in Table 5. These values reflect the more stringent of the Federal or New Jersey State drinking water standards available at the time the ROD was issued. For chemicals which to do not have promulgated MCLs, alternate risk-based values are provided in Table 6. When the ESD was issued, some of the MCLs listed in Tables 5 of the ROD were updated (ESD Table 2) to reflect the more stringent of the current Federal and New Jersey State MCLs.

As stated in both the ROD and ESD, the groundwater extraction, treatment and recharge remedy must continue to operate until the aquifer restoration standards are achieved. As long as groundwater remediation is required, treated groundwater must meet or be below the treatment standards listed in the ESD (Table 1). These chemical-specific treatment standards reflect the more stringent of the following:

- Toms River discharge limits specified in the OU-1 ROD;
- New Jersey State Groundwater Quality Criteria or antidegradation standards;
- Federal or New Jersey State drinking water standards (MCLs), whichever is more stringent; and
- New Jersey Department of Environmental Protection and Energy (NJDEPE) Discharge to Groundwater Limits.

2.3.1.3 Consent Decree/Statement of Work

In 1993, a Consent Decree (CD) was executed between EPA and Ciba, which allowed Ciba to design and install the components of the OU-1 groundwater remedy (the groundwater extraction, treatment and recharge systems), as established in the ROD and subsequently modified in the ESD. Appendix B of the CD, the Statement of Work (SOW) (EPA 1994, Appendix B) provides the remedial design criteria and remedial action requirements for the groundwater remedy. Specifically, the primary remedial design criteria for the groundwater extraction, treatment and recharge system are to:

- Capture up to 4.0 million gallons per day of the groundwater contaminant plume, including site-related contamination beyond the Facility property boundary.
- Be capable of on-site recharge of one hundred percent (100%) of the treated groundwater.
- Recharge in such a manner as to 1) not cause the horizontal or vertical spread of groundwater contamination beyond the capture zone; 2) not interfere with the natural flow of groundwater to the river in the areas underlying the Manchester Township Pine Lake Park subdivision; and 3) not allow recharged or contaminated groundwater to flow under the residential areas of Pine Lake Park.
- Have sufficient useful life to operate until the cleanup standards for aquifer restoration are achieved.

In accordance with the CD and associated SOW, construction of the groundwater extraction, treatment and recharge system was completed and the system became fully operational in March 1996. In 1997, full automation of the system was completed and the Final Remedial Action Report was issued (Engineering Science 1997).

2.3.1.4 Groundwater Extraction, Treatment and Recharge System

The groundwater extraction, treatment and recharge system consists of three distinct, but interrelated elements. The first element is the groundwater extraction system, which is used to extract and transport contaminated groundwater to the treatment facility. The second element is the groundwater treatment system, which is designed to treat the contaminated groundwater to meet or be below the cleanup standards for groundwater treatment (ESD Table 1). The third element of the system is the recharge of the contaminated groundwater on-site. All three elements are integrated into a distribution control network that operates the process systems automatically.

The groundwater extraction system includes forty-three (43) extraction wells that are designed to extract a total of 4.0 million gallons per day (MGD) of contaminated groundwater. The locations of these wells are shown on Figure 2-25. The well locations and extraction rates were determined through hydrogeological modeling. Currently, the total nominal flow of the system is about 2.5 MGD. The groundwater is conveyed from extraction wells via pipelines to a common header where it enters the groundwater treatment plant.

The groundwater treatment process consists of a series of treatment steps. The basic technologies used in the groundwater treatment process, in order, are: 1) Powdered Activated Carbon Treatment (PACT®); 2) clarification and separation of the sludge/carbon from the PACT® effluent; and 3) Granular Activated

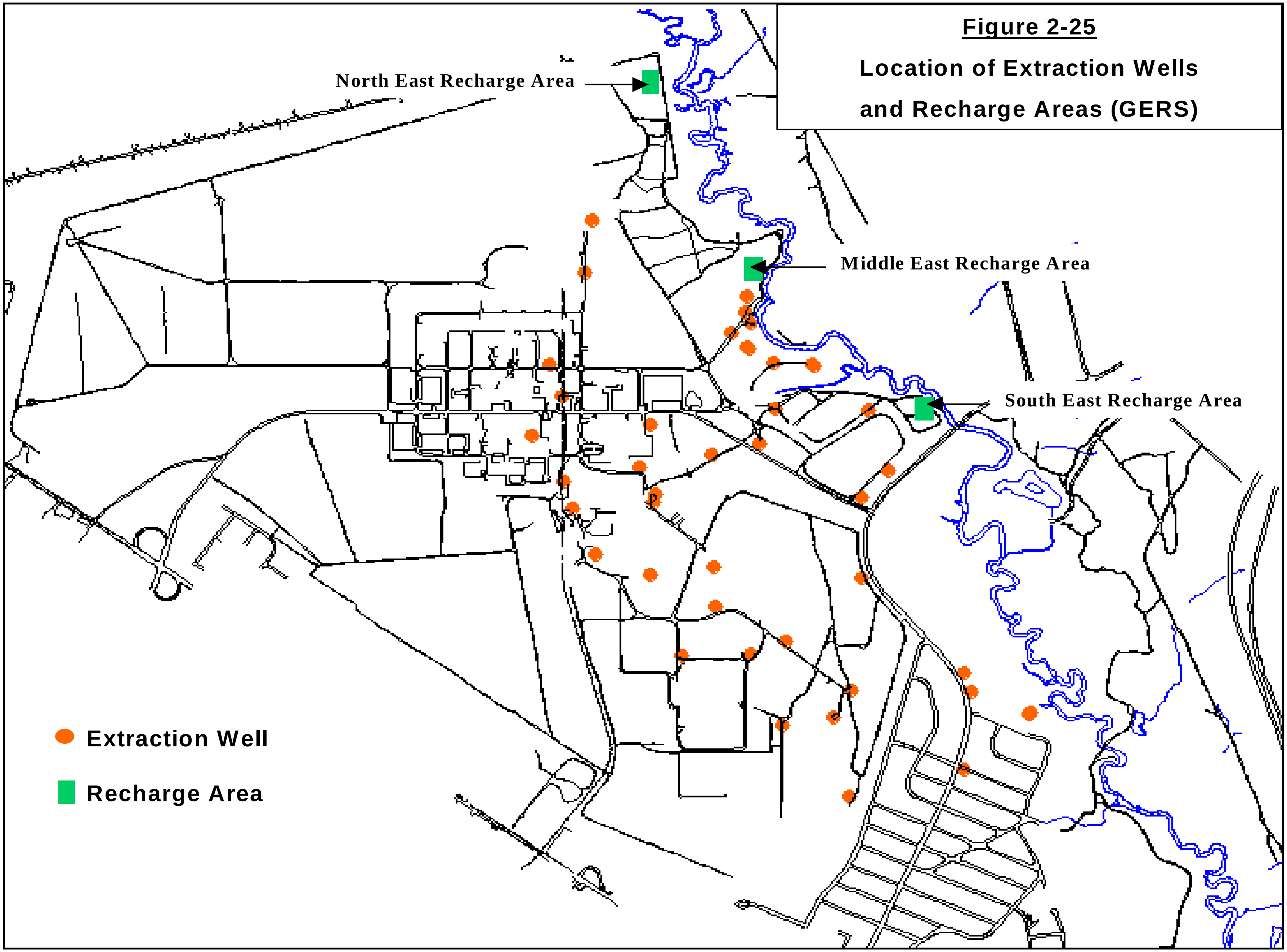


Figure 2-25
Location of Extraction Wells
and Recharge Areas (GERS)
North East Recharge Area
Middle East Recharge Area
South East Recharge Area
Extraction Well
Recharge Area

Carbon (GAC) adsorption. The first and second treatment steps (PACT® and clarification processes) already existed as part of the third generation wastewater treatment plant. The third treatment step (GAC adsorption) was added so that the water would be treated to meet or be below the groundwater treatment cleanup standards (ESD Table 1). A schematic of the groundwater treatment process is shown on Figure 2-26.

There are two (2) compliance points associated with the groundwater treatment system which monitor the untreated groundwater (compliance point I03) entering the treatment plant and treated groundwater (compliance point I01) exiting the treatment plant. Compliance point I03 is a monitor only location, while compliance point I01 must meet or be below the groundwater treatment standards specified in Table 1 of the ESD. These compliance points were sampled monthly during the treatment system's first year of operation and are now sampled quarterly.

There were three (3) recharge areas constructed for discharge of the final treated water (see Figure 2-25), based on an anticipated maximum groundwater extraction rate of 4.0 MGD. However, since the groundwater remediation system began operation, it has been determined through hydrogeological modeling that a total groundwater extraction rate of about 2.7 MGD is sufficient for capture of the contaminant plume. Based on this flow rate, one of the recharge areas has primarily been used. This area is referred to as the "North East Recharge Area" and contains three (3) discrete recharge points. This area is located in the northeastern corner of the Facility, near Pine Lake Park.

➢ Interim Groundwater Extraction System

In 1984, an interim groundwater extraction system was implemented by Ciba in 1984. This system was installed based on the results of remedial investigations conducted by Ciba and its consultants in the early 1980s. These early hydrogeologic investigations were focused primarily on groundwater quality in the southeastern area of the Site. Based on these early results, it was determined that a system of five (5) groundwater extraction wells would capture the major zones of groundwater contamination. The wells were installed on-site near the Filtercake Disposal Area and Drum Disposal Area. These five (5) extraction wells and the system to convey the extracted groundwater to the third generation wastewater treatment plant were installed in 1984 and the system became operational in early 1985. In 1986, two (2) additional extraction wells were installed near the Equalization Basins. This interim seven (7) well recovery system, which extracted approximately 0.5 million gallons per day, operated from 1985 to 1996

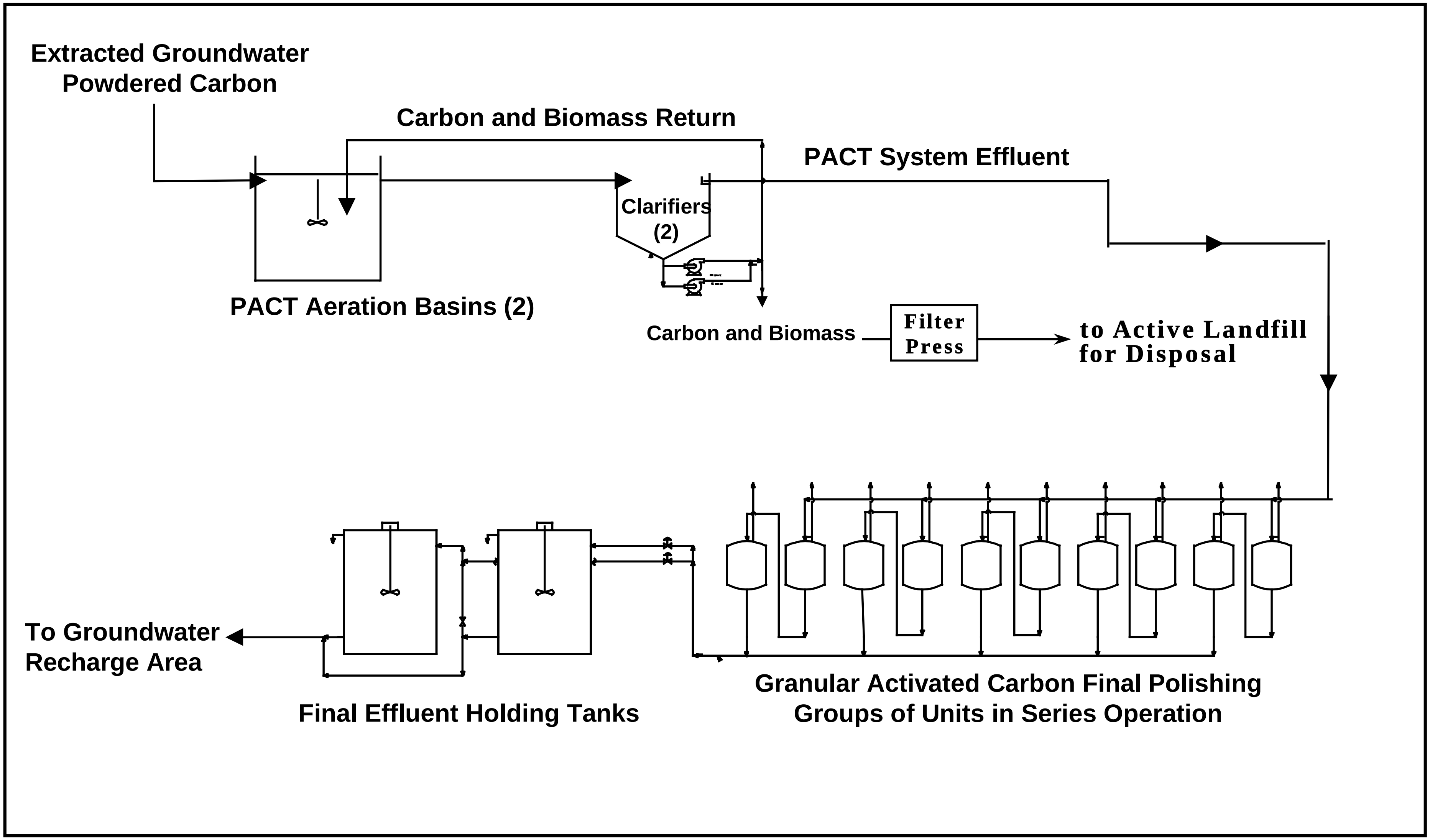


Figure 2-26

**Toms River Site
Groundwater Treatment System**

(until the full scale groundwater extraction system was installed). During the design and construction of the full-scale (43 well) groundwater extraction system, these seven (7) wells were either replaced by new extraction wells or were integrated into the final system.

2.3.1.5 Long-Term Monitoring Plan

In the OU-1 Statement of Work (SOW) (EPA 1994, Appendix B) the following statement is made regarding operation and maintenance (O&M) of the groundwater extraction, treatment and recharge system and the goal of aquifer restoration:

> " The GERS [Groundwater Extraction and Recharge System] and GTS [Groundwater Treatment System] shall operate until the Cleanup Standards for Aquifer Restoration as set forth in Table 2 of the ESD attached as Appendix D of the Consent Decree, are achieved in all designated monitoring points in the Upper Sand Aquifer and if necessary the Lower Sand Aquifer, for thirty-six (36) consecutive months during the O&M period….[of the groundwater extraction, treatment and recharge system]."

As stated in the SOW, one of the O&M requirements for the groundwater extraction and recharge system (GERS) was the development of a Long-Term Monitoring Plan (LTMP) for groundwater. The sampling requirements for the LTMP are provided in Appendix E of the O&M plan for the groundwater extraction, treatment and recharge system (Ciba 1995a). The LTMP replaced an earlier groundwater monitoring program called the Sampling, Analysis and Monitoring Plan (SAMP) (Ciba 1995a, Appendix A). The SAMP provided for semiannual sampling of site-wide groundwater monitoring wells in 1994 and 1995 to verify the design of the GERS prior to its implementation.

Since implementation of the GERS in 1996, the LTMP now provides for continued groundwater monitoring during its operational lifetime. The purpose of the LTMP is to provide a basis for assessing the effectiveness of the GERS and achievement of aquifer restoration. The monitoring program includes evaluation of the groundwater in the Upper and Lower Sand Aquifers, the Toms River, the wetlands adjacent to the Facility, the area east of the Toms River and the North East Recharge Area which borders Pine Lake Park. As stated in the SOW, the primary monitoring components of the LTMP (Ciba 1995a, Appendix E) are as follows:

1. Annual sampling of site-wide groundwater monitoring wells both on-site and off-site to determine the current definition of the groundwater plume, ensure that the plume is being adequately captured and monitor the progress of groundwater aquifer restoration. This data is used to monitor the

groundwater quality and hydraulics in the Upper and Lower Sand Aquifers beneath the Site and adjoining areas, as well as the performance of the groundwater extraction well network. The sampling requirements for this monitoring program (as well as Items 2 and 3, below) are provided in the Site-Wide Monitoring Program (Ciba 1995a, Appendix E, Attachment 1).

2. Semiannual sampling of monitoring wells immediately east of the Toms River to determine if pumping rates of the United Water Company's Parkway Well Field has altered the direction of groundwater flow to the Toms River and/or is capturing recharged or contaminated groundwater. This monitoring program focuses on groundwater hydraulics, specifically the groundwater divides of the Primary and Lower Cohansey aquifers in the vicinity of the Toms River.

3. Semiannual sampling of monitoring wells along the Site's northern border (adjacent to Pine Lake Park) to determine the effect of treated groundwater recharge on the existing groundwater underlying Pine Lake Park. Both water quality and hydraulic data are collected.

4. Semiannual sampling of the Toms River and adjacent wetlands to evaluate the effect of groundwater extraction and recharge on these areas. The sampling requirements for the Toms River are provided in Attachment 2 of the LTMP (Ciba 1995a, Appendix E). This data is used to assess surface water quality in the river and whether the groundwater remedy is impacting river water quality. The wetlands operational monitoring program (Ciba 1996a) evaluates whether there is any impact from the GERS on areas of the Site that are delineated as wetlands.

The sampling associated with the LTMP has been in effect since the groundwater extraction, treatment and recharge system became operational in early 1996. The most recent results for the site-wide groundwater monitoring are contained in the LTMP second annual groundwater monitoring report (Ciba 1999a). The current results for the groundwater monitoring east of the Toms River, groundwater monitoring in the vicinity of Pine Lake Park and the surface water monitoring of the Toms River, are provided in the LTMP fourth semiannual monitoring report (Ciba 1999b).

A detailed characterization of the contaminant plumes, based on a compilation of the SAMP, LTMP and additional historical groundwater data, is provided in Section 3.2, "Aquifer Characterization."

2.3.2 OPERABLE UNIT 2

As discussed previously, the activities associated with the historical operations at the Facility have resulted in contamination of surface and subsurface soils, as well as the groundwater beneath the Site. The initial RI Report (NUS 1988a) defined the nature and extent of groundwater contamination and the OU-1 FS Report (NUS 1988b) evaluated potential remedial alternatives for addressing the groundwater contamination. The RI and FS Reports formed the basis for EPA's selection of the groundwater extraction, treatment and recharge system as the remedial alternative to address groundwater contamination. This groundwater remediation system has since been designed and implemented.

The initial RI Report concluded that potential source areas on-site have resulted in groundwater contamination in the Upper Sand Aquifer underlying the Site. These potential source areas are collectively known as Operable Unit 2 (OU-2). Based on the data generated during the initial RI, thirteen (13) potential source areas were identified which may contribute to groundwater contamination at the Site. However, the initial RI data did not provide sufficient detail on the nature and extent of contamination within the source areas to determine an OU-2 cleanup remedy. The OU-1 ROD (EPA 1994, Appendix A), which focused on the remediation of groundwater contamination in the Upper Sand Aquifer, also required that further investigations be conducted to evaluate the potential sources of contamination. EPA deferred remedy selection for the potential source areas until the nature and extent of contamination could be more fully understood.

To this end, in 1990 EPA began the Source Control RI, which further characterized the original thirteen (13) potential source areas and identified additional potential source areas. Sampling of groundwater, surface water, sediments, surface and subsurface materials and air was conducted under this investigation. Based on the RI data, a total of twenty (20) primary potential source areas and one (1) secondary potential source area were identified and characterized. In 1992, supplemental field investigations were conducted in three (3) of the potential source areas (the Filtercake Disposal Area, the Drum Disposal Area and the Borrow Compactor Area) to further characterize contamination and waste deposits in these areas. A detailed discussion of the results from these can be found in the Source Control RI Report (CDM 1994a) and the Test Pit Program Investigation Report (Engineering Science 1993a).

A physical description and chronology of the operational history for the twenty-one (21) potential source areas identified in the Source Control RI Report (CDM 1994a) was presented in Section 2.2. A detailed characterization of each potential source area, which includes the results of the above referenced investigations and additional source area data collected to date, is presented in Section 3.0, "Site Characterization."

2.3.2.1 Administrative Order on Consent/Statement of Work

In 1995, the Operable Unit 2 (OU-2) Administrative Order on Consent/Statement of Work (AOC/SOW) (EPA 1995a) was executed, which directed Ciba to perform, under EPA oversight, a Feasibility Study (FS) for the twenty-one (21) potential source areas referenced in the Source Control RI Report (CDM

1994a). These potential source areas, which were previously described in Section 2.2, are presented below.

1. Backfilled Lagoon Area (Final Polishing Pond)
2. Backfilled Lagoon Area (Oxidation Lagoon)
3. Backfilled Lagoon Area (Settling Lagoon)
4. Backfilled Lagoon Area (Southern Sludge Drying Bed)
5. Backfilled Lagoon Area (Northern Sludge Drying Bed)
6. Drum Disposal Area
7. Filtercake Disposal Area
8. Lime Sludge Disposal Area
9. East Equalization Basin
10. West Equalization Basin
11. Production Area
12. Borrow/Compactor Area
13. Casual Dumping Area
14. Calcium Sulfate Disposal Area
15. East Overflow Area
16. Fire Prevention Training Area
17. Ocean Outfall Basin
18. Overflow Basin
19. Old Oxidation Lagoon
20. Old Wastewater Treatment Plant
21. Marshland Area

(Note that the Standpipe Burner Area is an additional potential source area that was added after the Source Control RI Report was issued).

These potential source areas have contributed to the groundwater contamination at the Site and could continue to leach contaminants into the groundwater if they are not remediated. This continued release of contaminants into the groundwater would prolong the time it takes for the OU-1 remedy (the groundwater extraction, treatment and recharge system) to clean up groundwater to the aquifer restoration standards (ESD Table 2). As stated in the AOC/SOW, the objective of the OU-2 FS is to provide an evaluation of potential remedial alternatives for each of the source areas (or group of source areas) to enable EPA to select a remedy that will:

- Be protective of human and the environment; and
- Facilitate the OU-1 remedial goal of aquifer restoration, or shorten the overall timeframe that the groundwater extraction, treatment and recharge system must operate.

The OU-2 FS provides the framework for addressing the potential source areas based on these objectives. The tasks required for completion of the OU-2 FS, as stated in the AOC/SOW and the report deliverables associated with each task, are presented in Table 2-1. The detailed requirements for each task is provided in Appendix 1 of the AOC/SOW (EPA 1995a).

2.4 Current Site Conditions

As described previously, currently all production activities at the Facility have been terminated. Manufacturing activities took place from 1952 to 1996, during which time various production facilities were constructed, expanded and eventually phased out of operation. Currently, all of the buildings that were associated with historical production activities have been decommissioned and demolished, except those associated with the on-going remediation activities.

The historical manufacturing operations, wastewater treatment and disposal practices have resulted in the contamination of soil and groundwater at the Site. The groundwater contamination is being addressed by the groundwater extraction, treatment and recharge system (GERS/GTS), which has been operating at full-scale since March 1996. The groundwater remedy prevents future off-site migration of contaminated groundwater. The contaminated groundwater is not impacting the public drinking water supply and under the current land use, no on-site groundwater receptors exist. As part of the groundwater remedy, institutional controls are in place to prevent the future installation of drinking water wells within the affected area. The GERS/GTS will continue to operate until the aquifer restoration standards are met.

Twenty-one (21) potential source areas have been identified at the Site that could continue to leach contaminants into the groundwater if they are not remediated. This continued release of contaminants into the groundwater would prolong the time it takes to clean up groundwater to the aquifer restoration

TABLE 2-1
AOC/SOW TASKS FOR FEASIBILITY STUDY

AOC Task	Description of Task	Report Title	Reference
1.0	**Remedial Objectives**		
1.1	Remedial Objectives Plan	Feasibility Study Work Plan	Ciba 1998b
1.2	ARARs & TBCs Identification	Feasibility Study Work Plan	Ciba 1998b
1.3	Modeling Studies		
1.3.1	Kd Study	Modeling Studies Report	Ciba 1998c
1.3.2	Method for Estimating Current Leachate and Sorption Properties	Modeling Studies Report	Ciba 1998c
1.4	Contaminant Transport Model		
1.4.1	CTM Work Plan	Modeling Studies Report	Ciba 1998c
1.4.2	Draft Interim Modeling and Calibration Report	Modeling Studies Report	Ciba 1998c
1.4.3	Draft Calibration and Modeling Report	Section 5.0 of FS Report	
1.5	Remedial Objectives Report	Sections 4.0 and 6.0 of FS Report	
2.0	**NAPL Action Program and Related Studies**		
2.1	NAPL Action Plan	NAPL Action Report (Ciba 1998c)	Ciba 1998a
2.2	Paleontological Investigation	Interim Paleontological Report	Ciba 1995b
		Addendum to Paleontological Report	Ciba 1996b
2.3	PCE/TCE Investigation for Wells 1151/1152	Interim Report on Investigation of PCE/TCE Near Industrial Waste Landfill	Ciba 1995c
2.4	Background Groundwater and Soil Quality Study	Background Groundwater and Soil Quality Study Report	Ciba 1998d
3.0	**Feasibility Study Scoping and Planning**		
3.1	Feasibility Study Work Plan	Feasibility Study Work Plan	Ciba 1998b
4.0	**Treatability Studies**		
4.1	Determination of Candidate Technologies and the Need for Treatability Studies	Candidate Technologies Memorandum	Ciba 1997a
4.2	Quality Assurance and Quality Control, Health and Safety and Additional Plans	QA/QC Plan for the Bioremediation Pilot Study	Ciba 1996c
4.3	Treatability Study Deliverables		
4.3.1	Treatability Study Work Plans	In-Situ Bioremediation Study Work Plan	Ciba 1996d
		Ex-Situ Bioremediation (Composting) and Laboratory Studies Work Plan	Ciba 1998e
4.3.2	Status and Draft Reports on Treatability Studies	Biopilot Startup Report	Ciba 1997b
		Biopilot Quarterly Report #1	Ciba 1997c
		Biopilot Quarterly Report #2	Ciba 1997d
		Biopilot Quarterly Report #3	Ciba 1998f
		Biopilot Quarterly Report #4	Ciba 1998g
		Interim Report on Aerobic Composting Study	Ciba 1999c
5.0	**Development and Screening of Remedial Alternatives**		
5.1	Refined Remedial Action Objectives	N/A	
5.2	General Response Actions	Section 8.0 of FS Report	
5.3	Identifying Zones and Media of Concern	Section 3.0 of FS Report	
5.4	Identify, Screen and Document Remedial Technologies and Remedial Alternatives	Sections 7.0 and 8.0 of FS Report	
6.0	**Detailed Analysis of Alternatives**	Section 9.0 of FSReport	

standards. The objective of the OU-2 FS is to provide an evaluation of potential remedial alternatives for each of the potential source areas (or group of source areas) to enable selection of an OU-2 remedy that is protective of human and the environment and will facilitate aquifer restoration.

Together, the on-going OU-1 remedy and the future OU-2 remedy will be integrated into an overall site remedy to address the cleanup of contaminated surface soils, subsurface soils and groundwater at the Site.